DIVISION OF ENVIRONMENT
QUALITY MANAGEMENT PLAN

PART III:

BUREAU OF WASTE MANAGEMENT
QUALITY ASSURANCE MANAGEMENT PLAN

Kansas Department of Health and Environment
Division of Environment
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1.0 Quality Assurance/Control Objectives, Criteria, and Procedures

Quality assurance (QA) and quality control (QC) objectives within KDHE's solid and hazardous waste management programs are intended to ensure all monitoring and analytical data collected by BWM staff are scientifically valid, defensible and, when practical, of known and acceptable precision and accuracy. The remainder of this document describes the procedural QA/QC criteria developed to meet these objectives.

The fundamental data collection activity performed by BWM is environmental sampling. Standard operating procedures (SOPs) that describe the procedures to conduct inspections and collect environmental samples are presented in Appendix A. These SOPs are generally to support environmental sampling and the staff performing associated activities, therefore this quality assurance management plan focuses on environmental sampling. Health and safety considerations are covered in a separate plan as outlined by the Division of Environment's Health and Safety Policy.

A site-specific sampling plan that outlines data quality objectives and sample collection locations needs to be established for each sampling activity. The plan needs to utilize approved procedures defined in the Division of Environment Quality Management Plan, more specifically those SOPs under BWM and BER. As referenced in BWM-005, SOPs from the Bureau of Environmental Remediation (BER) are utilized by BWM staff when sampling groundwater (BER-01), surface water (BER-02), soils (BER-03), or sediments (BER-04). BER SOPs are also utilized for decontamination of sampling equipment (BER-05), collection of quality control measures for water-quality data samples (BER-12), and evaluation and validation of data (BER-11).

2.0 Sampling Site Selection Criteria

The selection of field sampling locations is based on several factors including type and purpose of sample, representativeness, prevention of sample contamination, accessibility, and safety.

When possible, map reconnaissance shall be conducted prior to arrival in the general area of the site. Field staff will, to the best of their ability and under the scope of the project, familiarize themselves with general terrain, major waterways, road networks, unique topographical features, and other manmade objects or natural features in order to select sample locations. Factors which may influence site selection include: representativeness, accessibility, relationship to known or suspected sources of pollution, relationship to other influencing contaminated locations, availability of media to sample, and potential safety hazards.

Selection criteria may also vary depending upon the type of medium being sampled. The medium could include: groundwater, surface water, wastewater, other liquids, soil, sludge, other solids, or other waste materials.

Samples of unknown materials can present the highest danger to field staff. Special care must be taken to avoid or control conditions that may become dangerous to human health and the environment. Safety concerns at industrial sampling sites include strong acids and bases, toxic materials, toxic atmospheres, slippery floors, electrical hazards, heavy equipment, and confined spaces, to name a few. It is important that the sampler have the necessary safety equipment and safety training. The 40-hour Health and Safety Training Course and annual 8-hour refresher course, is mandatory for those personnel collecting samples at industrial sites. Staffs are not trained for and will not enter confined spaces.

3.0 Sampling Procedures and Sample Custody

All samples shall be collected according to the procedures given in SOP BWM-005, located in Appendix A. The sample collector shall log the date, time, name, and location of the sample collection. The prescribed chain-of-custody procedures found in SOP BWM-006 will be followed at all times.

4.0 Analytical Procedures

Analytical procedures used in the waste management program vary greatly due to the complexity and number of possible wastes to analyze. Samples shall be analyzed using EPA/SW-846, or alternate laboratory techniques approved by EPA and the State of Kansas. All analytical procedures shall be performed by the KDHE laboratory or a laboratory certified by KDHE. The analyst shall record the dates the analyses were performed, who performed the analyses, analytical techniques/methods used, and the results of such analyses.

Detection limits necessary for success of the project as well as the sample container, preservation, handling, and holding times, are unique for the analysis requested and must be agreed upon in advance with the analyzing laboratory according to their standard operating procedures.

5.0 Internal Procedures for Assessing Data Precision, Accuracy, Representativeness and Comparability

5.1 In-house Audits

The Bureau QA Representative, in conjunction with the section chiefs and program/project managers, conducts annual audits of sample, collection, analysis, and data recording procedures. Each audit is comprised of a system audit that consists of a qualitative review of QA systems. Each section chief is responsible for submitting to the Bureau QA Representative an annual QA report for each of their programs/projects that is subject to this QMP (see Part I , Section 4.7 of the QMP).

5.2 Quality Control Samples

The possibility of sample contamination during sample preparation, storage and analysis is assessed through the use of quality control samples, sometimes identified as blanks. These blanks are subjected to the same treatment as the rest of the samples collected as a result of the investigation or project. The type of blanks used, or the decision to use blanks will be made on a project specific basis by the program/project manager.

Should sample quality control problems be identified, the Bureau QA Representative will perform an unscheduled system audit. If necessary, the Bureau QA Representative will work with the laboratory to identify any contributing sources of contamination. The scope and magnitude of any sample contamination problem, as well as all measures implemented to resolve the problem, will be documented by the Bureau QA Representative in annual QA reports to the division director (see Part I, Section 4.7 of the QMP).

At the discretion of the Bureau QA Representative, the bureau director, or the division director, blind reference samples, spiked with known concentrations of one or more parameters, may be submitted to the laboratory and used as a general indicator of the overall accuracy of the data reported by the laboratory.

5.3 Procedures for Addressing Staff Performance Problems

Should a member of the project staff have difficulty with a given work procedure (e.g., as determined during an internal performance audit) an effort is made by the Bureau QA Representative to identify the scope and seriousness of the problem, identify any data affected by the problem, and recommend an appropriate course of corrective action. All affected data are either deleted from the file or flagged within the file, at the discretion of the Bureau QA Representative. Possible corrective actions include further in-house or external training for the employee, a reassignment of work duties, or modification of the work procedure.

6.0 Data Management

Completed sample analysis reports from the laboratory are delivered by mail to the appropriate program staff, as defined on the sample submission form. Copies of the analysis reports shall be sent to the Bureau QA Representative. The data are checked by the Bureau QA Representative for conspicuous oversights or dubious results. Should problems be noted in the data reports, the program staff, program/project manager, or Bureau QA Representative shall verify the data with the laboratory. If problems continue, the data will not be used. Each analysis report is electronically filed at the laboratory; hard copies are filed in the appropriate BWM file.

7.0 Quality Assurance Reporting Procedures

The Bureau QA Representative is responsible for informing the bureau director and division director of the QA/QC status and needs of the solid and hazardous waste management programs. The Bureau QA Representative is also responsible for maintaining adequate communication with KDHE Division of Health and Environmental Laboratories (KHEL) with regard to program QA/QC concerns.

In addition to these routine communication requirements, the Bureau QA Representative prepares an annual program QA/QC status report that is routed through the bureau director to the divisional QA officer. Each section chief and program/project manager shall also prepare reports for each of their programs that are subject to this QMP. These reports will contain the following types of information:

(a) Status of QA program plan;
(b) Description of data accuracy, precision, completeness, representativeness and comparability;
(c) Discussion of significant QA/QC problems, corrective actions, progress, needs, plans and recommendations;
(d) Results of internal and any external system or performance audits;
(e) Summary of QA/QC-related training performed since the last QA/QC status report; and
(f) Any other pertinent information specifically requested by the bureau director or the divisional QA officer.

APPENDIX A

BUREAU OF WASTE MANAGEMENT

STANDARD OPERATING PROCEDURES

KANSAS SOLID AND HAZARDOUS WASTE MANAGEMENT PROGRAMS

BUREAU OF WASTE MANAGEMENT
APPENDIX A
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STANDARD OPERATING PROCEDURE BWM-002

GUIDELINES FOR CONDUCTING RCRA INSPECTIONS

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SOP No. BWM-002

GUIDELINES FOR CONDUCTING RCRA INSPECTIONS

1.0 PRE-INSPECTION PROCEDURES

Prior to conducting a RCRA inspection, the inspector should take time to review the office files regarding the facility. This is to become familiar with the type and quantity of waste generated, disposal methods for regulated waste, compliance status, and contact person at the facility. In most cases, the inspection will be conducted on an "unannounced basis" (not pre-scheduled with the facility). The exception to this rule would be when the inspection will be facilitated by the presence of the contact person, the inspector may inform him of the date and time of the upcoming inspection. In these cases, only a 24 to 48 hour prior notice will be given.

The inspector should have the following items when conducting RCRA inspections:

- Sufficient copies of all inspection forms, including appropriate checklists;
- Copies of handouts to be given to facilities;
- The inspector's State of Kansas employee identification card;
- A supply of business cards;
- A clipboard and writing instruments;
- Sampling containers and sampling equipment (including laboratory forms);
- Appropriate health and safety equipment (i.e. protective eye wear, hearing protection, steel-toed boots, hard hat etc.);
- A digital camera for documenting findings and a disposable or regular 35 mm camera for a backup (Be sure to have extra disks or memory cards for the digital camera);
- Copies of both the Kansas and EPA Statutes and Regulations regarding hazardous/solid waste;
- Binoculars;
- Flashlight (preferably intrinsically safe).

2.0 INSPECTION PROCEDURES

Upon entering the facility, the inspector should identify himself as a Kansas Department of Health and Environment Staff Member, and request to see the contact person (if one has been previously identified). If no contact person is known, or if the contact person listed in the file is not available, the inspector should request to speak to someone in management. The inspector should present the contact person with a business card, and if requested, show his State of Kansas employee identification card.

If the inspector is refused entry to the facility, or to any facility records or processes that he must see to complete the inspection, he should first attempt to arrange for the plant manager to contact the Compliance and Enforcement Unit Chief of BWM by telephone. If the contact person refuses, the inspector should leave the plant site immediately and contact the BWM Compliance and Enforcement Unit Chief by telephone for instructions.

The entry phase of the inspection should take place in an office or conference room if possible, to allow a relaxed atmosphere free of the noise and distraction of any manufacturing areas of the facility. The inspector should explain the scope of the inspection, including whether it is routine, a follow-up, the result of a complaint, or for a special purpose. Examples of the type of information that should be obtained in this entry interview are: the kind of facility; number of employees; processes and products manufactured; types and quantity of wastes generated; and where wastes are disposed or recycled. At this time, the inspector should also inform the industry representative of his right to declare information confidential, so long as he has justification for such a request.

The following guidelines should be followed when completing inspection checklists and forms:

- All applicable items on the form should be addressed. If information is not available, this should be noted. If a section of the form does not apply, enter a N/A in that section.

- The summary of the inspection report should contain any information, which the rest of the form does not adequately cover. Examples include commitments made by the facility to forward information, environmental problems noted that might be of interest to another KDHE program, and diagrams of processes to help explain how specific waste streams are generated. The summary should also include a detailed description of all violations found.

After completing as much of the inspection as possible in the office, the inspector should request to be shown all process areas where hazardous or potentially hazardous waste are generated, stored, treated and disposed. Careful observation of all manufacturing processes may reveal a potentially hazardous waste, which the plant manager has neglected to review with the inspector. Examples of such wastes include those discharged to the sewer such as metal-treatment rinse waters, or liquids contained in tanks that may only be wasted every few years. The inspector should conduct a thorough walk through the entire plant and grounds. There may be disposal areas, either solid or hazardous waste, that are not easily visible on a general walk through of the process areas. The inspector should not let the plant manager rush or guide the inspection in any way. The inspector should follow all of the facility's safety guidelines at all times and should not proceed to any area of the facility without a facility representative.

After inspecting the process areas of the plant the inspector should request to review required documents (i.e. waste reports, manifests, service contracts, Material Safety Data Sheets, etc.). After completing the document review, the inspector should inquire as to whether additional facility personnel need to be present for the exit interview. The exit interview should include the review of all hazardous, or potentially hazardous, wastes generated; their generation rate, the amount presently in storage and their disposal methods. The plant manager should be given a Notice of Compliance/Non-Compliance (NOC/NC) during the exit interview. The inspector should review all items listed on the NOC/NC not in compliance with state or federal regulations. The NOC/NC should give a deadline for the correction of all items out of compliance. The inspector is given latitude in setting this deadline, but usually within 30 to 60 days, depending on the circumstances. If the facility is in compliance with all applicable regulations, they will be given an NOC/NC that will indicate that the facility was found to be in compliance.

During the exit interview, the inspector should also provide the plant manager with any guidance documents needed to correct deficiencies discovered during the inspection. The inspector should also answer any questions the facility may have and review any commitments the facility has made to supply the inspector with documents or test results. Due to the extremely complex nature of the hazardous waste program, the inspector should not feel obliged to provide an immediate answer to all questions. A promise to obtain the correct answer to the question and to forward this information to the industry representative fulfills the inspector's responsibility. Copies of the inspection report may be supplied to the facility upon request.

In some cases, it may be impracticable to issue a NOC/NC at the time of the inspection. In these cases, a letter will be issued to the facility outlining violations within 10 days of the inspection (if possible).

It should also be explained to the facility that reports are reviewed by BWM and that additional violations may be issued.

3.0 SAMPLING

During the course of the inspection, it may be necessary for the inspector to collect samples of a waste stream. Samples may be collected to determine if an unknown waste is hazardous, or to verify the results of analyses previously conducted by the facility. Samples may also be collected for other reasons not easily identified in this document.

Procedures for collection of any samples should be in strict accordance with the Standard Operating Procedure BWM-005 for Sampling.

4.0 POST-INSPECTION PROCEDURES

The completed NOC/NC or letter and inspection checklist/summary should be organized in the following manner:

- CMEL forms (only to be provided to the Compliance and Enforcement Unit Chief)
- NOC/NC or letter given or sent to the facility.
- Inspection checklist(s);
- Inspection summary
- Photographic logs;
- Supporting documentation.

The original forms should be forwarded in the above listed order to the Waste Compliance, Enforcement, and Policy Section Chief. A copy of these documents should be forwarded to the Compliance and Enforcement Unit Chief. A copy of these documents should also be maintained in the district waste files. Whenever an inspector conducts a RCRA inspection in a district other than his own, a copy of the letter and the entire inspection form should be forwarded to the district office for the district in which the facility is located.

STANDARD OPERATING PROCEDURE BWM-005

GUIDELINES FOR WASTE SAMPLING

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SOP No. BWM-005

GUIDELINES FOR WASTE SAMPLING

1.0 INTRODUCTION

In general, sampling of waste materials or contaminated media requires the collection of samples that are adequate in size and as representative as possible, depending on the reasons for sampling. Sampling situations vary widely. Therefore, no universal sampling procedure can be recommended. Rather, several procedures will be outlined for sampling different types of wastes in various states and receptacles.

The following steps should be taken prior to undertaking a sampling event:

- Research available background information about the waste (composition, form, concentration, etc.).
- Determine equipment and procedural needs for safe sampling.
- Consider proper locations for sampling.
- Determine the volume of samples to be taken.
- Review procedures for sample collection.
- Review procedures for containing and handling samples.
- Review chain-of-custody procedures.
- Identify necessary packaging, labeling, and shipping requirements.
- Schedule sample analyses with the laboratory.
- Review your sampling kit to ensure that all necessary equipment is included, as listed in Section III.

In some cases, it may be appropriate to conduct a preliminary survey of the facility prior to sampling. This would consist of a brief site visit and survey during which safety requirements of the site would be ascertained and a sampling plan developed by the program/project manager, or the inspector.

2.0 SAMPLING PLAN

If a sampling plan is developed, it should at a minimum include: purpose for the sampling; proposed procedures for sampling, including the type, depth, and number of samples; proposed locations of the samples (including site drawing if available); type of analysis for each sample (including type of container and amount of sample required for each test); and data review procedures.

3.0. SAMPLING EQUIPMENT

As a general rule, sampling equipment used should be disposable. Dippers, scoops, and similar devices for solids samples should be placed in plastic bags for later disposal or cleanup. Liquid samples from barrels or tanks should be withdrawn in inert tubing such as glass, and the tubing should then, if practical, be broken and abandoned within the barrel or tank. If incineration or recycling of the barrel contents is contemplated, disposal of the tubing may be in other suitable receptacles.

In cases where sampling equipment is reusable, decontamination of the equipment is necessary to avoid cross-contamination. Sampling equipment must be thoroughly cleaned with either soap and water or solvent.

In general, metal sample containers should not be used on hazardous waste site investigations, but if used they must be grounded, preferably to the drum or tank being sampled, while sample transfer is accomplished. All metal containers used should be stainless steel. Ambient air sampling on hazardous waste sites must be accomplished with spark-free equipment if explosive vapors are present (most sampling equipment can be a spark source).

The following is a list of sampling equipment. The list is subdivided into six sections: sampling equipment, testing equipment, shipping and packing equipment, documentation equipment, and other equipment. The following sections will discuss the application of the listed equipment.

<u>Sampling Equipment</u>
Sample containers (plastic and glass), caps, liners (check with laboratory)
Soil samplers (auger, scoop, steel spoon, shovels, etc.) (All stainless steel)
Non-sparking bung wrench
Wrench for loosening bolts on open-head drum rings
Colli-Wasa (liquid drum sampler)
Pans (plastic and aluminum)
Box Knife
Bailer

<u>Field Testing Equipment</u>
pH paper or pH meter
Water level indicator

Conductivity meter

<u>Shipping and Packing Equipment</u>
Vermiculite or equivalent packing material
Plastic bags
Sample labels
Tape (Clear and Duct)
Picnic coolers
Ice Packs
String or flexible wire
Zipper-type plastic bags (gallon size)

<u>Documentation Equipment</u>
Water proof felt tip pen
Sample Submission form
Field notebook
Custody Seals
Disposal and digital camera

<u>Decontamination Equipment</u>
Spray bottle with Alconox/water solution
Spray bottle with water
Distilled/deionized water
Alconox (detergent)

<u>Other Equipment</u>
Nylon rope
Plastic covers/ground cloth
Paper towels
First Aid kit
Bug spray (do not store with containers or decontamination equipment)
Sunscreen (do not store with containers or decontamination equipment)
Hand-wipes
Appropriate PPE (gloves, tyvek, booties, face shield, etc.)

4.0 SAMPLING PROCEDURES

Wastes encountered are usually multi-phase mixtures and are stored in receptacles of different sizes and shapes. No single series of sampling points can be specified for all types of receptacles.

The following procedures are recommended for sampling wastes in various media and types of receptacles. These procedures will need to be modified to meet the site-specific conditions and objectives. Receptacles (i.e., drums, tanks, etc.) should only be sampled when necessary to meet enforcement or clean-up requirements.

4.1 Sampling a Drum

Opening of drums or other sealed receptacles may be hazardous to sampling personnel unless proper procedures are followed. Gases can be released, or pressurized liquids can be expelled.

A bulging drum usually indicates that it is under high pressure and should not be sampled until the pressure can be safely relieved. A heavily corroded or rusted drum can readily rupture and spill its contents when disturbed and should not be sampled. Opening the bung of a drum can produce a spark that might detonate an explosive gas mixture in the drum.

Drums should not be moved or opened unless it can be ascertained beyond a reasonable doubt that the drum being moved is structurally sound. Drums standing on end, with bung up, should be opened by bung wrench. Drums on sides may be opened similarly if it is possible to safely rotate the drum so that the bung is high.

The following procedures should be observed:

- Choose a drum whose bung is up. (Drums with the bung on the top should be upright. Drums with bungs on the side should be lying on the side with the bung up.)

- Slowly loosen the bung allowing any gas pressure to release. Remove the bung and collect a sample through the bunghole with a disposable glass tube, which should be broken off afterwards and left in the drums, if possible.

- Replace the bung in the barrel after collecting a sample.

When there is more than one drum of wastes to be sampled at a site choose an appropriate method to establish sampling points.

4.2 Sampling a Vacuum Truck

Sampling a vacuum truck requires opening a drain plug or collecting a sample from the tank hatch using glass tubing, suction hose, or dipper. In some trucks obtaining a sample requires climbing access rungs to the tank hatch. These situations present accessibility problems to the sample collector. Preferably, two persons should perform the sampling: one person to do the actual sampling; the other to hand the sampling device to the sampler, to stand ready with the sample container, and to aid in case of any problems. The sample collector positions himself to collect samples only after the truck driver has opened the tank hatch.

The tank is usually under pressure or vacuum. The driver should open the hatch slowly to release pressure or to break the vacuum.

The following procedures are recommended:

Let the truck driver open the tank hatch.

Using protective sampling gear, assume a stable stance on the tank catwalk or access rung to the hatch.

Collect a sample through the hatch opening with a glass tube, which should be removed and disposed of properly.

If the tank truck is not horizontal, take one additional sample each from the rear and front clean-out hatches and combine all three samples in the same sample container.

When necessary, carefully take a sediment sample from the tank through the drain spigot.

4.3 Sampling a Barrel, Fiberdrum, Can, Bags, or Sacks Containing Powder or Granular Waste.

Dry powdered or granular wastes tend to generate airborne particles when the containers are disturbed. This may be a safety consideration. The containers must be opened slowly. The barrels, fiberdrums, and cans must be positioned upright. If possible, sample sacks or bags in the position you find them. Standing them upright might rupture the bags or sacks.

The following procedures are to be used:

Collect a sample from the container with the appropriate sampling device. Withdraw samples through the center of the receptacle and, if appropriate, at different points diagonally opposite the point of entry to try to obtain a composite of the entire container.

4.4 Sampling a Pond

Storage or evaporation ponds for hazardous waste vary greatly in size from a few meters in diameter to a hundred meters. It is difficult to collect representative samples from the large ponds without incurring astronomical expense and assuming excessive risks. Any samples desired beyond 3.5 meters from the bank may require the use of a boat, which is very risky. The information sought must be weighted against the risk and expense involved in collecting the samples. A pond sampler can be used to collect samples as far as 3.5 meters from the bank.

After observing all recommended safety procedures, the following procedures are recommended:

Divide the surface area of the pond into an imaginary grid. Take three samples, if possible; one sample near the surface, one sample at mid-depth or at center, and one sample at the bottom. Repeat the sampling at each grid section over the entire pond or site. If desired and appropriate, combine samples from equal depths into one composite sample.

4.5 Sampling a Waste Pile

A waste pile can range from a small heap to a large aggregate of wastes. The wastes are predominantly solid and can be mixtures of powders, granules, and large chunks.

If possible, take samples from at least three different points of the waste pile:

1) Near the top of the pile,
2) Around the pile near the center height, and
3) Near the base of the pile.

Additional samples may be required depending on the size of the pile and the reasons for sampling.

4.6 Sampling a Storage Tank

Sampling a storage tank usually requires climbing to the top of the tank through a narrow vertical or spiral stairway while wearing protective equipment and carrying sampling paraphernalia. This sampling should be conducted by no less than a two-person team. A representative of the company who should open the sampling hole that is usually located on the tank roof should accompany the sample collector.

If possible, collect one sample each from the upper, middle, and lower sections of the tank. If desired and appropriate, combine the samples in one container and submit it as a composite sample.

4.7 Sampling Contaminated Media

Groundwater, surface water, soils and sediments can all become contaminated. Standard operating procedures for sampling of these media are presented in the appendices of the BER portion of the Division of Environment QMP (BER-01 through BER-04 respectively).

4.8 Collecting a Wipe Sample for PCB analysis

For the most representative results the surface to be sampled must be smooth and impervious. It is important to communicate in advance with the laboratory that will be performing the analysis in case specific materials or procedures must be used in sample collection and preservation to fulfill their needs for analysis. The general procedure for sampling includes applying an appropriate solvent such as hexane to a piece of 11 mm filter paper or gauze pad. This moistened pad held by stainless steel forceps or freshly gloved fingertips must then be used to thoroughly swab an area of the surface to be sampled (designated in advance by using a template) to be precisely 100 cm^2. The template must be thoroughly cleaned between samples.

After thoroughly swabbing the area the resulting wipe must be stored in pre-cleaned glass jars at 4^O C prior to analysis. A field blank consisting of an unused pad moistened with the same solvent should also be collected and analyzed for each sampling event.

5.0 SAMPLE VOLUME, ORDER, AND PRESERVATION

A sufficient volume of sample must be collected, so that it is adequate in size for all needs, including laboratory analysis, and splitting with other organizations involved, etc. In collecting liquid waste samples in drums, vacuum trucks, or similar containers, 1,000 ml of a sample is usually sufficient. Hazardous wastes usually contain high concentrations of the hazardous components, so only a small aliquot of the sample is used for analysis.

When sampling contaminated media, the size and material of necessary sample containers varies greatly depending upon the media sampled, the analysis desired, and the specific laboratory that will perform the analysis. Check with laboratory personnel prior to the sampling event to ensure the proper containers are taken to the field.

The proper method for sample preservation will depend upon the type of media sampled and the requested analysis. Preservation methods can include both chemical and physical measures. Check with laboratory personnel prior to the sampling event to determine the necessary preservation methods.

All samples should be taken in the proper order if possible. The proper order will be from the area of least suspected concentration to the area with the most suspected concentration. Also, when a given sample will be analyzed for several parameters (i.e. volatiles, metals, semi-volatiles, etc.), the sample containers should be filled as follows: volatiles (including OA-1), semivolatiles (including OA-2 and PNAs), pesticides and herbicides, miscellaneous inorganics (pH, conductivity, Total solids, etc.), and then metals.

6.0 DUPLICATE SAMPLES

If applicable, pre-select sampling locations where duplicate samples will be collected at random. All duplicate samples should be collected with the same equipment as the original sample. Duplicate samples should be collected and analyzed in the same manner as the other samples. The purpose of the duplicate sample is to check for sampling variations.

7.0 SPLIT SAMPLES

Split samples should always be offered to a facility in advance of sampling. Aliquots of the collected sample should be given to the permittee or regulated facility, if requested. In most circumstances, the permittee or regulated facility should provide their own sample containers. If they do not have the appropriate container, then the inspector should provide a container.

STANDARD OPERATING PROCEDURE BWM-006

SAMPLE CHAIN OF CUSTODY PROCEDURES

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SOP No. BWM-006

SAMPLE CHAIN OF CUSTODY PROCEDURES

1.0. INTRODUCTION

After collection and identification, all samples shall be maintained under chain of custody procedures. If the sample collected is to be split with the owner or operator of the site or with other regulatory agencies, it should be allocated into similar sample containers. Sample labels with identical information should be attached to each of the samples and marked as "split". The requesting official may be required to supply the appropriate containers.

Each person involved with the sample must know chain of custody procedures. Due to the evidentiary nature of sample-collecting investigations, the possession of samples must be traceable from the time the samples are collected until they are introduced as evidence in legal proceedings. To maintain and document sample possession, chain of custody procedures must be followed.

2.0. SAMPLE CUSTODY

A sample is under custody if: a) it is in the sampler's actual possession; or b) it is in the sampler's view, after being in his/her physical possession; or c) it was in the sampler's physical possession and then he/she locked it up to prevent tampering; d) it is in a designated and identified secured area, or e) if the sample is secured with tamper resistant Custody Seals while in storage.

3.0. FIELD CUSTODY CONSIDERATIONS

As few people as possible should handle the samples. The field sampler is personally responsible for the care and custody of the samples until they are transferred or properly dispatched.

4.0. TRANSFER OF CUSTODY AND SHIPMENT

- A sample collection form that contains the chain of custody record must accompany samples. When transferring the possession of samples, the individuals relinquishing and receiving will sign and date the sample collection form. This form documents transfer of custody from the sampler to another person, to a mobile laboratory, or to the permanent laboratory.

- Whenever samples are split with a facility or government agency, a separate chain of custody record should be prepared for those samples and marked to indicate with whom the samples are being split.

- Sample collection forms showing identification of the contents should accompany all packages. The original form will accompany the shipment, and the inspector should retain a copy.

- If sent by a common carrier, a bill of lading should be used. Receipts for bills of lading should be retained as part of the permanent documentation.

STANDARD OPERATING PROCEDURE BWM-007

GUIDELINES FOR FIELD SCREENING AT RCRA FACILITIES

TABLE OF CONTENTS

Concurrences and Approvals

Concurrences: Bureau of Waste Management

Name: Jim Rudeen
Title: Chief, Waste Reduction, Compliance and Enforcement Section

Signature Jim Rudeen Date 1-4-06

Name: Dennis Degner
Title: Chief, Solid Waste Permits Section

Signature Dennis A. Degner Date 1/5/06

Name: Mostafa Kamal
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Signature M. Kamal Date 1/6/06

Approvals: Bureau of Waste Management

Name: Brad Roberts
Title: Quality Assurance Officer, Bureau of Waste Management

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Signature William L Bider Date 1-9-06

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Name: Bill Morris
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SOP No. BWM-007

GUIDELINES FOR FIELD SCREENING AT RCRA FACILITIES

1.0 INTRODUCTION

Field screening of potentially contaminated material is a valuable tool in the field. This SOP provides a description and operating instructions of certain field screening equipment.

2.0 DIGITAL pH METER

Function: pH meter is a battery or line operated digital pH/mV/temperature meter with automatic temperature compensation (ATC)

Follow the manufacturers directions for calibration and use.

3.0 YSI - SALINITY CONDUCTIVITY TEMPERATURE METER (S-C-T)

Function: S-C-T Meter is portable, battery powered, transistorized instrument designed to measure salinity conductivity and temperature:

Follow the manufacturers directions for calibration and use.

STANDARD OPERATING PROCEDURE BWM-008

USE OF DIGITAL CAMERAS FOR RCRA INSPECTIONS

TABLE OF CONTENTS

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SOP No. BWM-008

USE OF DIGITAL CAMERAS FOR RCRA INSPECTIONS

1.0 INTRODUCTION

1.1 Purpose

To assure that consistent and reliable standards exist and are adhered to by all technical staff performing investigations and inspections requiring photographic documentation. This document discusses the protocol and rationale for using a digital camera for documentation, when the use of traditional film cameras are justified, sets forth minimum requirements to ensure the credibility of digital photographs (photos), and provides suggested practices related to digital camera use and technology.

1.2 Program Scope

A sharp, clearly lit photograph is often only second to the inspector's personal observation of the subject when it comes to case winning evidence. Traditionally, the Bureau of Waste Management (BWM) has relied solely on silver-halide film photography for visual documentation, however, technological advances and the potential for budgetary savings have led the program to employ the use of digital cameras by almost every field staff member. This SOP shall apply to all photo documentation performed in the course of any RCRA solid or hazardous waste investigation.

2.0 USE OF PHOTOGRAPHIC FORMATS

2.1 Silver-Halide Film Cameras

Traditional silver-halide film cameras are not to be used on a routine basis to document field investigations. Exceptions to this rule are the use of “disposable” 35mm cameras when a digital camera is not available or is malfunctioning.

2.2 Digital Cameras

Each office shall make available digital cameras for documentation of field investigations. The camera must use a unique file identifier, time, and date stamp. It is not necessary that the time and date stamp appear on the printed image, only that they be recorded when the image is captured.

3.0 PHOTOGRAPH REQUIREMENTS

3.1 Accuracy

The digital photograph has several advantages to traditional film photographs; reduced costs, greater security, accessibility, and the ability to instantly review photos taken during the investigation. However, if the photo does not accurately represent what you saw, these advantages become moot. All staff must be familiar with the operation of the camera before proceeding with an investigation. If the photo is used as evidence in an enforcement case, the person in the field when the photograph was taken may be asked to verify the authenticity of the image, how it was acquired, its relevance to the case, and how it corroborates testimony as to issues which may be disputed in the case.

3.2 Photograph Composition

Photographs should be taken of every violation or questionable item/event found during an investigation. The three most common mistakes to avoid in providing photographic documentation are too few photographs, poor quality photographs, and lack of subject identification in photographs. Photographic documentation should tell the story with as little need for narrative as possible. This is done by capturing three types of images in a series.

The “establishing shot” is a photograph taken from a distance that shows not only the subject, but also one or several permanent landmarks that can be used for reference in establishing the exact location. It may actually be necessary in some cases to take several “establishing shots” in order to correctly reference the subject. You may also wish to indicate a compass orientation to further establish the location of the subject matter.

The “subject shot” should emphasize a specific object or event. Sometimes it will be taken in a series so that all sides of the subject can be viewed. Removable “Post-its” may be used to identify the item in the photograph. Numbers or identifiers on the “Post-its” should be recorded in the inspection notes for reference and easy identification when writing your report.

Lastly, a “detail shot” may be needed to provide further information about the item or event in question. Most digital cameras have a macro feature that will allow close-ups to be readily obtained.

3.3 Zoom

Most digital cameras are equipped with two types of zoom feature, optical and digital. Optical zoom is “true zoom” or telephoto, which makes the image appear closer without losing detail. It is acceptable to use the optical zoom feature to obtain more representative images. Digital zoom is merely built-in computer image enlargement, which makes the image appear closer by making it bigger. Unless it is absolutely necessary to use digital zoom, possibly because of safety concerns with getting too close to the subject matter, using digital zoom should be avoided.

4.0 ESTABLISHING PROPER CHAIN OF CUSTODY

4.1 Before the Investigation

Verify that the camera has sufficient battery life for the investigation. Also verify that the date, time, filename, and other applicable settings are correct. Ensure that there is enough storage media for the anticipated number of photographs to be taken.

4.2 During the Investigation

One of the advantages of digital cameras is that photos can be reviewed immediately to be certain that important details are captured and notes can be corroborated. Any poor quality pictures can be deleted and shot again before scene conditions change. <u>This is the only time when pictures may be deleted</u>. The preferred format for photo documentation is TIFF (Tagged Image File Format), however, this format results in very large files and is not recommended when more than a few photos are being captured. For most investigations, the camera should be set to capture images in JPEG (Joint Photographic Experts Group) format. While this format is classified as a "lossy" format, meaning that repeated viewing, which decompresses and then re-compresses the file, may result in degradation of the image, the loss should not affect the integrity of the evidence. Also, the file identifier on the camera should be set to name each photo in sequential rather than series mode, so that every picture taken with that camera has a unique filename.

4.3 After the Investigation

DO NOT VIEW THE IMAGES ON A COMPUTER UNTIL THEY HAVE BEEN PROPERLY ARCHIVED

Immediately after the investigation is completed, the camera and all media storage devices used during the investigation should be taken back to the office and downloaded onto a secure computer equipped with a compact disc writer. The images should be placed in a computer folder that has been named with the facility name or identification number, and the date of the inspection. An example would be "KSD123456789042103", which would be the investigation of KSD123456789 on April 21, 2003. Another example would be "JohnSmithDump042103". Do not erase any images.

Each office should maintain, in a secure location, a compact disc for archive storage of all photographs taken during RCRA investigations. Make sure that the compact disc is labeled “CD-R” and not “CD-RW”. The compact disc should be labeled with the title “RCRA Inspection Photographs: Enforcement Sensitive”, along with the office name, disc number, and the accumulation start date for the disc. When the disc is nearly full, the last inspection date should also be placed on the label.

After downloading the images to the computer, copy the folder to the compact disc. Return the compact disc to the secure location. You may now view the images on the computer or copy the images to other storage devices, such as floppy disks, other computers, or e-mail.

4.4 Report Preparation

It is not necessary to include all pictures in the inspection report, but each violation should be supported by photo documentation. All photos referenced in the report text must be attached, and all photos attached must be referenced.

Include a statement in your report which states “The digital photographs contained in this report were recorded directly to an archival file or electronic media (such as a compact disc, digital versatile/video disc, or tape) prior to viewing on a computer system. KDHE certifies that such digital photographs are thus identical to the digital photographs taken during the inspection/investigation.”

If it is necessary to enlarge, lighten, or otherwise alter an image to provide greater clarification, this transformation should be noted in the report. If the image is altered, do not name it the same as the original. Instead, place “mod” at the end of the file name, such as “MVC253mod.jpg”.

Facility Photograph Log

4. Photographer____
5. Facility Name_______________________________________
6. Facility Identification Number (if available)___________________
2. Type of Camera Used_________________________________
3. Digital recording media _______________________________
4. Photos were Archived by _________________________
5. Archive CD:________________________________

Date	Time (camera recorded time)	Photo Filename (MVC-xxx.jpg)	Modifications made to digital image (if any)	Description of Image

STANDARD OPERATING PROCEDURE BWM-009 FOR THE GARMIN GPS III+

TABLE OF CONTENTS

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Signature William L. Bider Date 1-9-06

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Signature Bill Morris Date 1-10-06

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Signature Ronald Hammerschmidt Date 1-17-06

STANDARD OPERATING PROCEDURE FOR THE GARMIN GPS III+

1.0 INTRODUCTION

1.1 Purpose

This Standard Operating Procedure (SOP) will outline the functionality of the Garmin GPS III+ for the Bureau of Waste Management (BWM). The Garmin GPS III+ is a handheld navigation tool to be used primarily to assist field staff to find a predetermined location (sample point/area), to determine spatial relationships, and to mark locations of interest for computer database entry and mapping.

1.2 Program Scope

The Garmin GPS III+ has a horizontal positional accuracy of **4-7 meters (12-20 ft.)** with Selective Availability (SA) off and good satellite coverage. If the satellite coverage is limited (less than 4) the accuracy could drop to **10-20 meters (33-66 ft.)** The unit can be used for navigation, and to acquire point location for general information, such as the front gate of a facility.

The unit can be used to locate specific sampling sites (such as monitoring wells or air sampler locations) where the relative location between sites is important as long as individual sites are not within **40 meters (132 ft.)** of each other. If greater levels of accuracy are required, for detailed mapping or legal definition, the user should consider using the AshTech Reliance system, the Magellan ProMark system or conventional land surveys.

The unit can be used to map points for GIS features with the restriction that polygons of less than **40 meters (132 ft.)** on a side may not reproduce well in the mapping software. If higher levels of accuracy are required and/or the information will be used primarily for mapping, the user should consider using the AshTech Reliance system, the Magellan ProMark system or conventional land surveys.

This procedure applies to the Garmin GPS III+ units only. The elements of this SOP will be applicable to all Garmin GPS III+ deployed within the BWM. Operators/staff collecting data for databases/mapping shall conform to the SOPs of the Geographic Services Unit within the Office of Information Services under the Office of the Secretary. This SOP (BWM-009) will describe the necessary training for field operation, maintenance, and troubleshooting of the Garmin GPS III+.

2.0 MINIMAL TECHNICAL QUALIFICATIONS AND TRAINING OF OPERATOR

A. The operator shall be familiar with all applicable procedures described in the operator's manual.
B. The operator shall be familiar with this SOP and any applicable Bureau/Program SOPs.
C. The Bureau's/Program's GPS Administrator verifies who is ready to operate the unit.

3.0 OPERATIONAL INSTRUCTIONS

A. The operator shall inspect the GPS unit and related equipment for proper, safe operation before going to the field. Any problems with the unit detected by the operator shall be reported to his/her Bureau's/Program's GPS Administrator. Refer to the troubleshooting section for additional information.

B. The Garmin web site (http://www.garmin.com/support) should be visited periodically by the Bureau's/Program's GPS Administrator to check for the availability of product updates for the GPS III+ operating software and/or the *MapSource*® software.

C. Unless permission has been given beforehand by the Bureau's/Program's GPS Administrator, only he/she may delete waypoints or change settings on the unit.

D. Operators should be mindful of the quality of all data to be submitted for database and mapping purposes, and should keep appropriate documentation to validate their data sets.

4.0 INITIAL CALIBRATION OF UNIT

A. Allow the unit approximately five minutes to "**AutoLocate"** itself under the following circumstances.
   a. The first time it is used out of the box.
   b. After it has been moved with the power off over 500 miles from last usage point.
   c. If it's memory has been cleared and all internally stored data has been lost.
   d. After a software update.

B. The following procedure describes how to change the settings that need to be changed by the Bureau's/Program's GPS Administrator before the unit is given out for field data collection.
   a. From any screen press the "**MENU**" button twice to bring up the "**Main Menu"** screen.
   b. Highlight **"Setup"** and press the "**ENTER/MARK**" button.
   c. Using the rocker keypad, select the **"Time"** tab at the top of the screen.
   d. Select the **"Time Format"** field and press the "**ENTER**" button.

e. Highlight "**UTC"** and press the "**ENTER**" button.
f. Select the "**Time"** tab at the top of the screen and move to the "**Position"** screen.
g. Select the "**Position Format"** field and press the "**ENTER**" button.
h. Highlight "**hddd.dddd**" press the "**ENTER**" button.
i. Leave all remaining user settings at default values.
j. Press the "**QUIT**" button once to return to the "**Main Menu"** screen, and twice to return to the screen you started out at.

5.0 USING THE GPS III+ UNIT

A. Try to give the antenna a clear and unobstructed view of the sky.
B. Turn the unit on by pressing and holding the red "**POWER**" button until the screen turns on.
C. Allow the unit approximately one minute to acquire satellite information. Do not move the unit during this process.
D. After the unit has switched from the "**Satellite Status Page"** to the "**Map Page**," it is ready for use. If you switch back to the "**Satellite Status Page**," it should read "**3D Navigation"** at the top of the screen.
E. The unit has six main pages that are linked together and provide content related information to the user. Pressing the "**PAGE**" key moves through the main pages in normal fashion. The "**QUIT**" key moves through the pages in reverse order.
F. Each page has a menu screen used to change fields/settings or input data. Pressing the "**MENU**" button once on one of these menu screens can access the menu screens. Pressing the MENU button again will bring up the "**Main Menu"** for the unit, where you can access the "**Setup"** screen along with other features.
G. Turn the unit off by pressing and holding the red "**POWER**" button until the screen turns off.

6.0 DATA COLLECTION PROCEDURES

6.1 <u>Waypoint naming convention</u>

A. Before the unit is taken out in the field a suitable naming convention will be developed between the Bureau's/Program's GPS Administrator and the field operator.
B. One suggestion is to have the person in charge of the unit set a "dummy" waypoint at a predetermined three digit number, such as 500, before it is handed out.
C. After this "dummy" waypoint is set, each new waypoint collected in the field will be automatically numbered consecutively by the unit starting with 501, 502, 503, ...
D. If this method is used you may skip steps 6.2.C.a-d**,** because you will not need to alter the name of the waypoint.

E. A log should be taken out in the field to record and link the waypoint name/number with a more detailed description of the location. The three digit waypoint numbers stored by the unit can then use this log to identify the waypoints. This is necessary because the unit can only store six characters in the waypoint name field; many times more than six characters are needed to describe the point.

F. The information included in the log can later be added to the ASCII text file created when the data is processed. See 7.0.B.r of this document.

6.2 <u>Instant reading waypoint collection</u>

A. Go to either the "**Map Page"** or "**Position Page**."

B. With the unit held steady at the desired location, hold down the "**ENTER/MARK"** button until "**Mark Waypoint"** screen pops up.

C. If you wish to change the waypoint name/number follow steps below, otherwise skip to 6.2.D.

a. Highlight the name field to the left of "**Done"** using the rocker keypad and press the ENTER button.

b. Input a name for the waypoint by using the rocker keypad. Up and down go through the available characters. Left and right changes the position of the cursor. The waypoint name can be up to six characters.

c. Press the "**ENTER**" button to store the edited waypoint name.

d. Use the rocker keypad to highlight "**Done."**

D. Press the "**ENTER**" button to save your position.

E. Write down any additional data about the waypoint on a log sheet.

6.3 <u>Average position waypoint collection</u>

A. Follow the above procedure.

B. With the unit in the same position that the waypoint was taken, press the "**MENU**" button, highlight "**Average Position"** and press the "**ENTER**" button.

C. Highlight "**Save"** and press the "**ENTER**" button when the "**Estimated Accuracy"** field and/or "**Measurement Count"** field reaches the desired value. **DO NOT** move the unit while averaging the position.

D. Highlight "**Done"** and press the "**ENTER**" button to save your position.

E. It takes about 1 minute to collect 60 measurement counts.

6.4 <u>Accuracy of waypoint collection</u>

A. With SA turned off you can expect the Garmin III+ GPS unit to calculate it's location within **4-7 meters (12-20 ft.)** of it's true position, but if the unit does not have good satellite coverage that range could increase to **10-20 meters (33-66 ft.)**

B. With SA turned on you can expect errors of **100 meters (330 ft.)** when taking an instant reading waypoint. Using the average position format for waypoint collection may help to reduce the error.

C. Methods to reduce error

a. Avoid electrical interference; i.e. avoid taking measurements near electrical substations or high voltage power lines.
b. Make sure antenna has a clear view of sky. (Try to stay away from areas with dense vegetation overhead.)
c. **Check the Estimated Position Error (EPE)** and **Dilution of Precision (DOP)** on the **Satellite Status Page**. Low numbers are better accuracy, and high numbers are worse for each. The **DOP** measures satellite geometry quality on a scale of one to ten. The **EPE** uses the **DOP** to calculate a horizontal position error in feet/meters. **A DOP <4.0 shall be required for all waypoints submitted for database/mapping purposes.**
d. Check the **Satellite Status Page** and make sure the unit has a good lock on at least four satellites. The unit works best when it is receiving strong signals from many satellites located at different angles from the unit. The left side of the screen shows the position of the satellites in the sky. The satellites are displayed by an assigned number. Highlighted satellites are being used by the unit to determine it's location. The right side of the screen shows the strength of each satellite signal the unit is receiving. The higher the bar the better the signal. A grey bar indicates that the unit has found the satellite and the receiver is collecting data from it. A black bar indicates that the unit is using that satellite to calculate it's position.
e. If available, a powered antenna can help to reduce error by improving the reception of satellite signals.

7.0 DATA PROCESSING

A. Uploading Waypoint data from Garmin unit to a PC using *MapSource®* software
   a. Connect the Garmin to the PC using the supplied interface cable.
   b. In the menu bar go to "**File / Open From GPS...**"
   c. Select waypoints and click on "**OK**."
   d. By clicking on the waypoint tab on the left of the screen you can see a list of all the waypoints you have collected.
   e. Save the *MapSource®* file (***.mps**) for future reference.
      1. In the menu bar go to "**File / Save as...**"
      2. Type the desired name for the file in the File Name field. The file name chosen should conform to your Bureau's/Program's SOPs.
      3. Hit "**ENTER**" to save the file.

B. Export waypoint data from *MapSource®* program to an ASCII comma delimited text file.
   a. Select the waypoint tab in the left hand window.
   b. Select all of the waypoints from the left of the screen that you want exported using a shift or control click (**Ctrl + A** selects all).
   c. Copy (**Ctrl + C**) the waypoints to the clipboard.

d. Open a spreadsheet program such as Corel Quattro Pro.

e. Paste (**Ctrl + V**) the waypoints to a worksheet.

f. This will create a spreadsheet giving you a table of information regarding your waypoints. Included are the waypoint name, time and date of waypoint collection, and the lat/long coordinates of the waypoint.

g. Select the column with the lat/long coordinates.

h. Select "**Tools / Data Tools / Quick Columns**."

i. Select the "**Block"** option for the source.

j. Select the Destination columns by clicking on the arrow button next to the entry block. This will temporarily close the Quick columns Expert window to allow you to select these columns. Select the currently selected column and the one next to it using a shift click, then click on the "**Maximize**" button on the Quick columns Expert window.

k. Click the "**Options**" button.

l. Select "**Delimited**" from the "**Data Type**" pull down.

m. Select "**Space**" for the delimiting type (selection buttons).

n. Click "**OK**."

o. Click "**Parse."**

p. Click "**Yes**" to overwrite the existing data.

q. The coordinates should now be in two columns one for the latitude and one for the longitude

r. Delete the columns you do not need (Symbol & Name, Unknown). Make any editorial changes you need to make to Descriptions, ID numbers, etc. Be VERY careful NOT to alter the coordinates. You will NOT need to add column headings. The GIS analyst will add them.

s. Saving this file as an ASCII text file in comma delimited form.

   1. In the menu bar go to "**File / Save as..."**

   2. Type the file name in the File Name field. The file name should include g3 (to indicate that a Garmin GPS III+ was used to collect the data), the first, middle and last initials of the person who collected the data, and the three-digit day of year with underscores between the three. (For example: g3_jjc_108 would indicate that a Garmin GPS III+ was used by James Joseph Cronin on April 17 to collect the points. If two people have the same initials use the first two initials and a last name to differentiate between the two.)

   3. Click on the File Type field and scroll down to select **ASCII Text ("**Comma delimited").

   4. Hit "**ENTER**" to save the file.

   5. The file should be put on a shared drive under a directory used to store ASCII text files including waypoint data and under a sub-directory indicating what year the information in the file came from.

t. Printing out this file will give you all the information you need to enter the locations into the GIS "FEATURE DATA" database of KDHE points, except for the county that the point is located in.

C. Using the information in the ASCII text file the feature locations can be entered into a larger database of KDHE sites using a Lotus Notes application called "FEATURE DATA." If interested, contact the GIS Unit at (785) 296-8078 for status and participation.

8.0 TROUBLESHOOTING

A. If the batteries run low, a warning box titled "**Battery Power Low"** will pop up on the screen. If you see this you should replace the batteries.

B. If the unit is not under sufficient satellite coverage, a warning box titled "**Poor GPS Coverage"** will pop up on the screen. If you see this, you need to move to another location to give the antenna a clearer view of the sky.

C. If a message pops up on the screen that you don't understand, refer to *Appendix E* in the <u>Owner's Manual & Reference</u> to get a description of the message.

D. If any irresolvable or unrecognizable problem occurs with the unit while being used for field data collection, the unit is to be turned off and returned to the Bureau's/Program's GPS Administrator for inspection.

9.0 DATA OUTPUT

A. Once features are entered into the database, you can use software such as Crystal, ArcView, and VB Viewer to create a table of features that suit your needs.

B. This table can then be used in ArcView to create a map of your feature locations.

C. With assistance from the GIS unit, you can get the features included on the KDHE Intranet IMS site, which will place your features on a map.

D. Any questions regarding map or table creation of desired feature locations should be directed to the GIS unit at (785) 296-8078.

E. The *MapSource®* software can also be used to perform a variety of tasks.

10.0 GLOSSARY OF TERMS

ASCII comma delimited text file	A file that separates columns of information with commas.
AshTech Reliance	A GPS unit that is more accurate than the Garmin GPS III+.
Average Position Waypoint Collection	Allows the user to average position samples over time and save the averaged result as a waypoint. Averaging reduces the effects of selective availability on position error and results in a more accurate position reading.

AutoLocate	The unit searches for available satellites to determine its position. This option is useful after relocating a long distance (>500 miles) from the last location the GPS III+ was used.
Dilution of Precision (DOP)	A measure of the GPS receiver-satellite geometry. A low DOP value indicates higher accuracy. The DOP indicators are GDOP (geometric DOP), PDOP (position DOP), HDOP (horizontal DOP), VDOP (vertical DOP), and TDOP (Time clock offset).
Estimated Position Error (EPE)	A measurement of horizontal position error in feet or meters based upon a variety of factors including DOP and satellite signal quality.
Feature Data database	A KDHE GIS database designed to store GPS information for various feature locations. It is currently in the testing phase.
Geographical Information System (GIS)	A computer system for capturing, storing, checking, integrating, manipulating, analyzing and displaying data related to positions on the Earth's surface.
Global Positioning System (GPS)	A global navigation system based on 24 satellites orbiting the earth at an altitude of 10,900 miles and providing very precise, worldwide positioning and navigation information 24 hours a day, in any weather. Also called the NAVSTAR system.
Horizontal Positional Accuracy	The accuracy of a location on a 2D surface.
Instant Reading Waypoint Collection	The unit takes it's current position reading and saves it as a waypoint.
Selective Availability (SA)	This is an artificial error introduced into the satellite data by the US DoD to reduce the possible accuracy of a position to 100 meters for commercial users. SA was turned off on 5/01/2000 through a federal executive order to encourage the use of GPS units for non-military purposes. It can be turned on again for national security reasons at any time.
Waypoint	The technical term for a location whose coordinates you store.

11.0 CHECKLIST OF APPLICABLE FIELD EQUIPMENT AND SUPPLIES

Garmin GPS III+ unit
Owner's Manual & Reference Guide
Carrying case
Cigarette lighter power adapter
PC Interface Cable
Garmin *MapSource®* software CD
Notebook for logging data
Powered antenna (optional)

STANDARD OPERATING PROCEDURE BWM-010

GUIDELINES FOR CONDUCTING a GROUNDWATER MONITORING SYSTEM OPERATION AND MAINTENANCE (O&M) INSPECTION

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SOP No. BWM-010

GROUNDWATER MONITORING SYSTEM OPERATION AND MAINTENANCE (O&M) INSPECTION

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to establish uniform procedures and inspection guidance for conducting an Operation and Maintenance (O&M) inspection at a RCRA regulated facility. The EPA requires an owner/operator to implement an O&M program based on the regulations stated under 40 CFR Parts 264, 265, and 270 of RCRA.

This document explains how to plan and conduct an O&M inspection. Pre-inspection procedures described in Section 3.0 will provide guidance on how to prepare for an O&M inspection. Section 4.0 provides field inspection procedures that describe what activities should be performed while visiting the facility. The final Section 5.0 explains the necessary steps to complete an O&M inspection report. The following attachments provide assistance with performing an O&M inspection and writing an O&M inspection report:

Attachment A.	O&M Inspection Check Sheet
Attachment B.	Operating Records Field Form
Attachment C.	O&M Inspection Field Form
Attachment D.	Equipment Checklist
Attachment E.	Groundwater Sampling Assessment
Attachment F.	O&M Report Outline
Attachment G.	Summary of Regulations Related to Operation and Maintenance Programs
Attachment H.	Technical Inadequacies to Look for in a Ground Water O&M Inspection

2.0 INTRODUCTION

The Operation and Maintenance (O&M) inspection evaluates how an owner or operator of a facility operates and maintains its RCRA groundwater monitoring system. Compared to the Comprehensive Groundwater Monitoring Evaluation (CME), the O&M inspection focuses primarily on operations of the groundwater monitoring system. An O&M inspection is designed to achieve the following enforcement objectives:

- Determine whether facility personnel are collecting groundwater samples in accordance with the owner/operator's Sampling and Analysis Plan (SAP) or sampling and analysis section of the RCRA permit.

- Determine whether the facility's sampling devices are in working order and that the owner/operator is abiding by maintenance provisions as outlined in the SAP or RCRA permit.

- Determine whether the monitoring wells and piezometers/observation wells within a groundwater monitoring system continue to yield representative groundwater samples and reliable hydrogeologic data.

- Identify deficiencies in regard to the operation and maintenance programs, including post-closure requirements such as landfill cap or security fence maintenance, or any need for more thorough scrutiny of the owner/operator's groundwater monitoring program.

- Identify issues or concerns that should be assessed in a future comprehensive groundwater monitoring evaluation.

- Collect groundwater elevation data; determine the direction of groundwater flow; and generally, assess the accuracy of the information reported by the facility since KDHE's last O&M inspection.

3.0 PRE-INSPECTION PROCEDURES

The inspector will perform coordination and scheduling of the O&M inspection with the facility contact person. Inspections are to be scheduled to coincide with the facility's regularly scheduled sampling events. Contact with the facility should be made one month to three months in advance to determine the anticipated dates that the work will be performed. Once the date has been set, the inspector will contact the EPA and KDHE District Office and notify them of the upcoming inspection.

Prior to conducting the O&M inspection, the inspector must thoroughly review the office files and RCRAInfo regarding the facility to develop a thorough understanding of the technical, regulatory, and enforcement aspects of the facility. The inspector will become familiar with the type and quantity of wastes generated, disposal methods for regulated wastes, compliance status, details of the groundwater system, and contact person at the facility. Prior to the inspection, the inspector should review the following:

- The owner/operator's Operating Records. The facility should have adequate documentation of operation and maintenance activities. (Attachment B includes an operating records checklist)

- Groundwater monitoring technical assessment reports. These reports generally provide most of the background information needed to become familiar with a facility's groundwater monitoring system.

- Previous inspection reports. These reports should be reviewed to determine a facility's compliance history including previous deficiencies documented in a CME or O&M report.

- Previous analytical data and permit applications. Previous groundwater analyses and permit applications will provide information concerning potential and actual groundwater contaminants. The knowledge of behavior of particular contaminants in groundwater is necessary to evaluate the adequacy of the monitoring well system and to determine personal equipment requirements during sampling operations.

- Hydrogeologic information. Site-specific hydrogeologic information may be obtained from RCRA Part B permit applications and from groundwater monitoring and assessment plans. Certain items should be copied and taken for reference during the inspection, if available, including:

    - Facility site map showing well locations
    - Monitoring well boring logs
    - Monitoring well construction details
    - Survey data on well elevations

- Sampling and analysis plan. This plan should be reviewed in detail so it can be critiqued during the inspection process.

- The owner/operator's post-closure plan. This plan includes a cost estimate for post-closure care, which should be reviewed for accuracy.

Copies of the sampling and analysis plan, post-closure plan, hydrogeologic data, and RCRA hazardous waste regulations specific to the project may be needed as reference material while at the facility. Also, as applicable regulations are not specific about what constitutes compliance for ground water monitoring system design, construction, operation, and maintenance, EPA's 1986 Draft Technical Enforcement Guidance Document (TEGD) and other EPA or KDHE guidance should be relied upon to set the standard for interpreting the regulations with respect to these elements. Project managers are encouraged to cite this and other guidance in O&M reports. In addition, the inspector will need to prepare the site inspection checklist to be taken to the facility. This checklist is included as Attachment C.

Prior to the inspection date, the inspector must consult the facility contact person regarding the health and safety procedures required by the facility. The inspector will then be able to gather the appropriate health and safety equipment necessary for conducting the inspection. Attachment D provides a list of field, sampling, and safety equipment that may be needed.

4.0 FIELD INSPECTION PROCEDURES

Upon arrival at the facility as prearranged with facility representatives, the inspector should meet with the facility contact person and properly identify him/herself with KDHE identification credentials. The facility contact person may accompany the inspector during the inspection process. The initial interview should be conducted with the facility contact person, if possible to outline the purpose and scope of the inspection. Items to be addressed include the following:

- A tentative schedule to accomplish the inspection tasks should be discussed and agreed upon to preclude any problems arising during the inspection process.

- Any specific concerns or requirements of the facility; e.g., signing in or out of the facility, visitor passes, restricted areas, limitations on the use of cameras, etc., should be discussed, clarified, and resolved.

- A copy of the facility's sampling and analysis plan may need to be obtained (if not available prior to the inspection), reviewed, discussed, and critiqued with the facility representatives. Specific procedural deficiencies should be pointed out for correction.

- Information obtained during inspection preparation should be verified for accuracy and completeness.

The inspector will perform the following tasks during the O&M inspection:

- Visually inspect all wells and piezometers (if time allows) noting evidence of significant damage or deterioration.

- Observe the techniques used by the owner/operator's sampling crew as they measure water levels, purge wells to be sampled, and collect groundwater samples.

- Document other items of concern specific to the facility, including issues associated with post-closure, such as landfill cap, security fence, or other maintenance.

- Create a photographic log of the facility site.

- Obtain site-specific data for each well and piezometer inspected.

- Collect split samples.

Attachment E includes detailed procedures that will provide additional guidance for performing the field inspection. Throughout the field inspection process, the inspector is required to complete the O&M inspection checklist that includes a photographic log and a monitoring well integrity worksheet. (Attachment C) The inspector will observe the sampling activities performed by the facility's sampling crew in order to determine whether the groundwater samples were properly collected and whether the techniques and procedures described in the owner/operator's SAP or RCRA permit were properly implemented.

5.0 POST-INSPECTION PROCEDURES

The inspector will transport or ship the samples obtained during the inspection to the laboratory for analysis the day of or the day after the inspection takes place. The inspector will document on RCRAInfo using a Compliance, Monitoring, and Enforcement Log (CMEL) form that the O&M inspection was performed. Documentation of deficiencies on RCRAInfo must wait until the facility has been notified.

In order to prepare for the O&M inspection report, the inspector will need to complete the following tasks:

- Construct a potentiometric surface map using water level data collected during the field inspection and compare it to the map routinely submitted by the owner/operator.

- Assess whether the owner/operator's sampling crew departed from the written sampling and analysis procedures contained in the owner/operator's SAP or RCRA permit.

- Identify deficiencies in the maintenance of sampling devices, monitoring wells, piezometers, or compliance with post-closure requirements.

- Identify deficiencies in the owner/operator's sampling program and/or operation and maintenance program.

Attachment F provides an outline of a KDHE O&M Inspection Report; however if the O&M is performed as part of a CME, consult the SOP on CMEs for writing the report (BWM-011).

Within 30 days of performing the inspection, the project manager needs to send a letter conveying preliminary findings of the inspection to the facility. At this time the RCRAInfo database is to be updated to list that the inspection was performed on the date of the field visit. The project manager should list any deficiencies that are included in the preliminary findings on the CMEL form, but should also indicate on the form that additional deficiencies may be determined prior to finalizing the report. Deficiencies that are clearly inconsistent with a regulation or a KDHE approved plan will be considered to be violations, and KDHE needs to communicate with the facility and schedule a date for the facility's return to compliance. Tables are provided within this SOP to assist the project manager in determining whether violations of applicable regulations exist; however, in addition to violations, the inspector occasionally notices conditions for which citing a violation is not warranted, but the facility should improve upon to avoid future problems. For each deficiency that is not a violation, KDHE should give a written recommendation to correct the deficiency. For this second type of deficiency, the information needs to be listed on RCRAInfo, but only in the comments section, not under violations.

Professional judgment will be necessary to a limited degree to distinguish between the types of deficiencies. One example of a deficiency that may, or may not, be a violation is a cracked concrete monitoring well pad. If the crack is a hairline fracture but no separation has occurred it is not a violation, but if separation of the broken pieces is enough to allow water to pass through, it is a violation. Another example would be the lack of a weep hole designed to allow any accumulated water to escape from inside the protective casing; where, if trapped, it could freeze in cold weather causing the inner casing to break. KDHE recommends a weep hole for each well, but many wells do not have one and this is not a violation.

By the end of August of each federal fiscal year, a copy of the draft report will be sent to the EPA and a copy of the draft report will be sent to the facility (Any mention of deficiencies will be left absent in the facility's copy of the draft report.) for a thirty-day review period. Following the draft review period, the project manager will revise the draft O&M report as necessary based on comments received, and prepare the final O&M report. By the end of September, the project manager will have completed and sent the final O&M report to the facility. A copy will be placed on file, another copy will be sent to the EPA. KDHE's cover letter to the facility will emphasize correction of those deficiencies within a specified time period. The project manager will take necessary steps to update the RCRAInfo database to list any deficiencies. The project manager will subsequently log onto RCRAInfo to verify that the data shows up as intended. Finally, as deficiencies are corrected, the project manager must ensure the database gets further updates as needed.

ATTACHMENT A

O&M Inspection Check Sheet

Facility:________________________________ Date:_____________________________

PRE-INSPECTION

- □ Schedule inspection date with facility contact person
- □ Notify EPA and KDHE District Office of the upcoming inspection
- □ Prepare vehicle and/or hotel reservations
- □ Review the following in the facility files:
  - The owner/operator's Operating Records (Attachment B)
  - Groundwater monitoring technical assessment reports
  - Previous inspection reports.
  - Previous analytical data and permit applications
  - Hydrogeologic information
  - Sampling and Analysis Plan (SAP)
  - Post-Closure Plan
- □ Bring copies of the following to the facility:
  - Sampling and Analysis Plan (SAP)
  - Post-Closure Plan
  - Hydrogeologic information (i.e., facility map with well locations)
  - RCRA hazardous waste regulations
- □ Prepare the Inspection Checklist by entering preliminary data (Attachment C)
- □ Gather the equipment necessary for conducting the inspection (Attachment D)
- □ Carry a KDHE employee identification card

SITE-INSPECTION

- □ Visually inspect the integrity of all wells and piezometers (if time allows)
- □ Observe the facility's sampling crew as they collect groundwater samples
- □ Document other items of concern specific to the facility
- □ Create a photographic log of the facility site
- □ Obtain site-specific data for each well and piezometer inspected
- □ Collect split samples

POST-INSPECTION

- □ Send split samples to laboratory for analysis
- □ Document inspection on CMEL form for RCRAInfo
- □ Send a letter to the facility notifying them of the preliminary results of the inspection
- □ Construct a potentiometric contour map to compare with facility's submitted maps
- □ Identify deficiencies in the maintenance of sampling devices, monitoring wells, and piezometers that necessitate KDHE recommendations
- □ Identify violations in the owner/operator's sampling and/or operation and maintenance program (Attachment E)
- □ Send a copy of a draft O&M inspection report to the EPA and the facility
- □ Complete the final O&M report and send copies to the EPA and the facility
- □ If necessary, update CMEL forms to report deficiencies and submit to RCRAInfo

ATTACHMENT B

Facility Operating Records

(Adapted from OSWER 9950-3 O&M Inspection Guide)

Facility:______________________________ Date:____________________________

Does the operating record:	Y	N	Notes:
Include annual reports of ground-water monitoring results including ground-water level data from each well and piezometer in the monitoring system?	☐	☐	
Include an inventory of all sampling devices and purging equipment in use at the facility and information on model number, serial number and manufacturers' name?	☐	☐	
Include detailed operating, calibration, and maintenance procedures for each sampling device?	☐	☐	
Describe decision criteria to be used to replace or repair sampling equipment and/or monitoring wells?	☐	☐	
Include schedules for performing operation and maintenance activities related to the ground-water monitoring system?	☐	☐	
Include records for ground-water monitoring which provide information on 1) the date, exact place and time of sampling or measurements; 2) the individual(s) who performed the sampling or measurements; 3) the date(s) analyses were performed 4) the analytical techniques or methods used; and 5) the results of such analyses?	☐	☐	
Include records of all monitoring information including all calibration and maintenance records?	☐	☐	
Include records of monitoring information including determination of ground-water surface elevations?	☐	☐	
Include a determination of ground-water flow rate and direction(s) in the uppermost aquifer on an annual basis (e.g., prepare a potentiometric map annually using data collected during the year)?	☐	☐	

ATTACHMENT C

RCRA OPERATION AND MAINTENANCE INSPECTION CHECKLIST

A.	SAMPLING EVENT PREPARATION [40 CFR 264.97 (e), 40 CFR 265.92 (a)]

		YES	NO	NA
A.1.	Did the sampling crew adequately prepare and check all equipment prior to mobilization? ______	☐	☐	☐
A.2.	Were field instruments properly calibrated and calibrations recorded in a field logbook? ______	☐	☐	☐
A.3.	Did the Sampling Crew have a copy of the SAP and QAPP in the Field?________________	☐	☐	☐

Notes:____

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☐ See Section J for additional information.

B.	WELL INTEGRITY [40 CFR 264.97 (c), 40 CFR 265.91 (c)]

B.1. Are the following elements of the well properly maintained? (See attached Monitoring Well Integrity Worksheet.)

		YES	NO	NA
a.	Protective outer casing and lock ______________________________	☐	☐	☐
b.	Concrete pad / surface seal ______________________________	☐	☐	☐
c.	Gas vent and weep hole ______________________________	☐	☐	☐
d.	Survey elevation mark clearly visible ______________________________	☐	☐	☐
e.	Primary casing ______________________________	☐	☐	☐
f.	Cap for primary casing ______________________________	☐	☐	☐
g.	Well identification markers ______________________________	☐	☐	☐
h.	Flush mount vault seal (water in vault?) ______________________________	☐	☐	☐

Notes:____

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☐ See Section J for additional information.

C.	STATIC WATER-LEVEL (SWL) AND TOTAL WELL DEPTH (TWD) MEASUREMENTS [40 CFR 264.97 (f), 40 CFR 265.92 (e)]

		YES	NO	NA
C.1.	Were static water level and total well depths measured from the well survey mark? _______	☐	☐	☐
C.2.	Were static water level and total well depths measured in accordance with the Sampling and Analysis Plan? If not, describe any variances. ___________________________________	☐	☐	☐
C.3.	Did the sampling crew obtain organic vapor reading at the wellhead prior to SWL or TWD measurements? ____	☐	☐	☐
C.4.	Did the sampling crew measure SWLs in the wells and total well depths prior to the collection of samples? ____	☐	☐	☐
C.5.	Did the sampling crew record measurements to 0.01 feet? ___________________________	☐	☐	☐
C.6.	Were all SWL measurements taken within a 24-hour period? __________________________	☐	☐	☐
C.7.	Was the water level probe decontaminated in accordance with the SAP? _______________	☐	☐	☐
C.8.	Were TWD measurements compared with "as built" well depths? _____________________	☐	☐	☐
C.9.	Was percent occlusion determined based on TWD measurements versus "as built" well depths? ____	☐	☐	☐

Notes:____

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☐ See Section J for additional information.

D.	DETECTION / SAMPLING OF IMMISCIBLE LAYERS [40 CFR 264.97 (f), 40 CFR 265.92 (a)]

		YES	NO	NA
D.1.	Are procedures used which would detect light or dense phase immiscible layers? ________	☐	☐	☐
D.2.	Are any detected immiscible layers measured or sampled separately prior to well purging?_	☐	☐	☐
D.3.	Do the sampling procedures minimize mixing with the aqueous phase? ________________	☐	☐	☐

Notes:____

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☐ See Section J for additional information.

E.	WELL PURGING AND SAMPLING PROCEDURES [40 CFR 264.97 (d), 40 CFR 265.92 (a)]

		YES	NO	NA
E.1.	Were clean disposable ☐latex, ☐nitrile, or ☐vinyl gloves worn during sampling? ________	☐	☐	☐
E.2.	Were gloves changed before each sample or as needed? ________	☐	☐	☐
E.3.	Were the wells sampled in the sequence outlined by the approved Sampling and Analysis Plan? (List the sampling sequence.) ________	☐	☐	☐
E.4.	Did the sampling crew sample background wells before sampling downgradient wells? ____	☐	☐	☐
E.5.	Did the sampling crew avoid placing clean sampling equipment, hoses, and lines on the ground or other contaminated surfaces prior to insertion in the well? ________	☐	☐	☐

Purge Procedures

		YES	NO	NA
E.6.	Were the wells purged in accordance with the approved Sampling and Analysis Plan? _____ ☐No-purge method ☐Low-Flow method ☐Borehole volumes	☐	☐	☐
E.7.	Were the wells purged using ☐Dedicated or ☐Non-dedicated equipment?			
E.8.	What equipment was used to purge the wells? ☐Bladder pump ☐Inertia pump ☐Suction pump ☐Submersible pump ☐Bailer ☐Other________			
E.9.	Did the sampling crew measure purge parameters in the field? Frequency of measurements________ ☐pH________ ☐Temperature________ ☐Specific Conductance________ ☐Dissolved Oxygen________ ☐Oxidation Reduction________ ☐Turbidity________ ☐Other________	☐	☐	☐
E.10.	Did the sampling crew collect the purge water for ☐storage and analysis, ☐on-site disposal, or for ☐shipment off-site to a RCRA treatment facility? ________	☐	☐	☐
E.11.	Did the sampling crew use the proper field method to calculate the volume of water to purge? ________	☐	☐	☐
E.12.	Did the sampling crew use the proper field method to measure the volume of water to purge? ________	☐	☐	☐
E.13.	Was a sufficient volume of water purged prior to sampling? ________	☐	☐	☐

Bailers

		YES	NO	NA
E.14.	Did the sampling crew lower and raise the bailer slowly to minimize disturbance and turbidity in the water column? ________	☐	☐	☐
E.15.	Did the sampling crew prevent the rope attached to the bailer from touching the ground? ___	☐	☐	☐

E.16. Were the bailer contents transferred to the sample container using techniques to minimize agitation and aeration? ________ ☐ ☐ ☐

E.17. Were bailers bottom valve bailers? ________ ☐ ☐ ☐

Pumps

E.18. Was the bladder pump discharge adjusted to a flow of 100 ml/min or less while collecting VOC samples? ________ ☐ ☐ ☐

E.19. Were the samples collected from the pump discharge tube (not from any purge device discharge tube)? ________ ☐ ☐ ☐

E.20. Was the pump discharge flow free of gas bubbles before each sample collection, as a test for bladder integrity? ________ ☐ ☐ ☐

E.21. Was bladder pump flow performance monitored regularly for drop-off in flow rate and discharge volume per cycle? ________ ☐ ☐ ☐

E.22. Were operating procedures established and followed to prevent the entry of drive gas into the sample flow or the bladder pump? ________ ☐ ☐ ☐

Sampling Procedures

E.23. Were the wells sampled within a 24-hour period after purging? ________ ☐ ☐ ☐

E.24. Were the proper sample containers and preservation methods used for each parameter or group of parameters to be analyzed? ________ ☐ ☐ ☐

E.25. List parameter, container type and volume, and preservation methods for each sample.

Parameter/Group	Sample Container	Preservation
VOCs		
SVOCs		
Pesticides/Herbicides		
Metals		
PCBs		
Other		

E.26. Were samples preserved in accordance with the approved Sampling and Analysis Plan? ___ ☐ ☐ ☐

E.27. Were sample containers ☐Pre-preserved or ☐Preserved in the field?

E.28. Did the sampling crew filter samples during sampling? ________ ☐ ☐ ☐

E.29. Did the sampling crew collect and containerize samples in the order of the volatilization sensitivity of the parameters in accordance with the Sampling and Analysis Plan? ________ ☐ ☐ ☐

E.30. Did a laboratory supply the sample containers? If not, describe the method used to clean the sample containers. ________ ☐ ☐ ☐

E.31. Were the sample containers labeled? ☐ ☐ ☐

E.32. Did the labels provide the following information?
- Facility / Site Name ☐ ☐ ☐
- Sample identification number ☐ ☐ ☐
- Well number ☐ ☐ ☐
- Name of collector ☐ ☐ ☐
- Date and time of collection ☐ ☐ ☐
- Parameter analyses requested ☐ ☐ ☐

E.33. Do the sample labels remain legible when wet? ☐ ☐ ☐

E.34. Were split samples collected for/by the regulatory agency? If yes, which wells were sampled? ☐ ☐ ☐

Notes:

☐ See Section J for additional information.

F. EQUIPMENT DECONTAMINATION [40 CFR 264.97 (d), 40 CFR 265.92 (a)]

YES NO NA

F.1. Were decontamination procedures completed in accordance with the approved Sampling and Analysis Plan? ☐ ☐ ☐

F.2. Was non-dedicated sampling equipment disposed in accordance with the Sampling and Analysis Plan? ☐ ☐ ☐

Notes:

☐ See Section J for additional information.

G. QUALITY ASSURANCE AND QUALITY CONTROL [40 CFR 264.97 (d) and (e), 40 CFR 265.92 (a)]

YES NO NA

G.1. Did the sampling crew calibrate the field equipment in accordance with the approved Sampling and Analysis Plan? ☐ ☐ ☐

G.2. Did the sampling crew follow proper maintenance procedures for the field equipment? ☐ ☐ ☐

G.3. Did the sampling crew prevent contamination of sampling equipment (i.e. tubing, probes, bottles)?______ ☐ ☐ ☐

G.4. Were the samples handled properly prior to analyses (immediately placed on Ice after collection, refrigerated, and secured)? ______ ☐ ☐ ☐

G.5. Does the Sampling and Analysis Plan require the following QA/QC samples?______

Trip Blanks - Was one trip blank prepared for each transport cooler containing VOC samples? How many trip blanks were collected?______ ☐ ☐ ☐

Duplicate Samples – From which wells were duplicate samples collected?______ ☐ ☐ ☐

Field Blanks - How frequently were field blanks collected?______ ☐ ☐ ☐

Equipment Blanks - How frequently were equipment blanks collected?______ ☐ ☐ ☐

G.6. Did the sampling crew maintain a field logbook and/or individual well sampling sheets? ______ ☐ ☐ ☐

G.7. Was the following information documented?
- a. Date and time of sampling ______ ☐ ☐ ☐
- b. Weather conditions ______ ☐ ☐ ☐
- c. Field sampling participants ______ ☐ ☐ ☐
- d. Observations and physical well integrity ______ ☐ ☐ ☐
- e. Field equipment descriptions ______ ☐ ☐ ☐
- f. Field analysis results ______ ☐ ☐ ☐
- g. Field equipment and calibration/maintenance information ______ ☐ ☐ ☐
- h. Any other pertinent field observations or unusual conditions ______ ☐ ☐ ☐

G.8. Who maintains the field logbook and/or individual well sampling sheets? ______

Notes:______

☐ See Section J for additional information.

H.	CHAIN-OF-CUSTODY [40 CFR 264.97 (d), 40 CFR 265.92 (a)]

YES NO NA

H.1. Was a chain-of-custody record included with each sample? ______ ☐ ☐ ☐

H.2. Were the following chain-of-custody items documented?
- a. Sample identification number ______ ☐ ☐ ☐
- b. Well number ______ ☐ ☐ ☐

c. Signature of collector ☐ ☐ ☐
d. Date and time of collection ☐ ☐ ☐
e. Sample container and preservative type ☐ ☐ ☐
f. Number of containers ☐ ☐ ☐
g. Parameter analyses requested ☐ ☐ ☐
h. Signature of all persons involved in the chain-of-possession ☐ ☐ ☐
i. Inclusive dates of possession ☐ ☐ ☐

H.3. How long are samples held prior to transport to the laboratory?

H.4. How are the samples transported/shipped to the laboratory (i.e., hand delivered, overnight express, etc.)?

H.5. Were sample seals attached to the containers or coolers to ensure that the samples are not tampered with while in transit? ☐ ☐ ☐

Notes:

☐ See Section J for additional information.

I.	General Post-closure Care [40 CFR 264.117 (a) and (b), 40 CFR 265.117(a) and (b)]

YES NO NA

I.1. Are the following elements of post-closure care being properly maintained?

a. Integrity of final cover (note any signs of erosion, subsidence, or drainage problems ☐ ☐ ☐
b. Security (fencing, signs, etc.) ☐ ☐ ☐
c. Leachate collection system ☐ ☐ ☐

Notes:

☐ See Section J for additional information.

J.	ADDITIONAL INFORMATION (Include field notes, inspection conclusions, and other details)

Notes:

Photograph Log

Number	Direction Facing	Description

Monitoring Well Integrity Worksheet

Well ID	Photo Number	Static Water Level	Total Well Depth	Product Level	Protective Casing Condition* (Good/Bad)	Lock in Place (Yes/No)	Concrete Pad Condition** (Good/Bad)	Weep Hole (Yes/No)	Survey Elevation Mark (Yes/No)	Inner Casing Condition (Good/Bad)	Inner Protective Cap (Yes/No)	Other

* Evidence of collision damage, casing degradation, identification number legibility
** Evidence of frost heaving, well subsidence

Comments: ____

____

____

ATTACHMENT D

Facility:______________________________ Date:______________________

EQUIPMENT CHECKLIST

Field Equipment:

- □ Digital camera (check batteries and memory card)
- □ Clipboard and writing instruments
- □ Bound field notebook
- □ Flashlight
- □ Calculator

Sampling Equipment:

- □ Sample collection containers
- □ Sample collection device (pump, bailer, or other)
- □ Wash bottle
- □ Plastic sheet/tarp, foil, and/or bags
- □ Cooler and ice
- □ Water level indicator/Interface Probe
- □ Temperature, pH, and conductivity meters
- □ Colli-Wasa (liquid drum sampler)
- □ Decontamination equipment (de-ionized water, non-phosphate detergent, brushes/buckets)
- □ Toolbox (hammer, hacksaw, knife, pipe wrench, socket set, duct tape etc.)

Health and Safety Equipment:

- □ Protective eye wear
- □ Steel-toed boots
- □ Hardhat
- □ Nitrile gloves
- □ Full-face and half-face respirator
- □ Long-sleeved shirt/coveralls
- □ First Aid Kit
- □ Sunscreen
- □ Bug spray
- □ Rain gear

ATTACHMENT E

GUIDANCE on CONDUCTING a GROUNDWATER SAMPLING ASSESSMENT for an OPERATION AND MAINTENANCE (O&M) INSPECTION

1.0 PURPOSE

This attachment provides detailed guidance for conducting a field inspection as part of an Operation and Maintenance (O&M) inspection at a RCRA facility where groundwater monitoring is required.

2.0 INTRODUCTION

Since the sample collection and handling procedures are critical for generating data that is valid and truly representative of the in situ groundwater, the consistency of the methods, equipment, and procedures are essential elements. The groundwater sampling assessment is the main component of the Operation and Maintenance (O&M) inspection performed at a RCRA regulated facility, which consists of an in-depth quality assessment review of the groundwater monitoring network and site hydrogeology. The primary function of the quality assurance assessment is to assure that the regulated facilities collect and analyze groundwater samples in accordance with accepted methodology and that the data generated and reported is valid and truly representative of the groundwater monitored. In addition, it provides essential information regarding the condition of the groundwater system and the site as a result of the visual observations on-site.

3.0 INSPECTION PROCEDURES

The quality assessment review of a groundwater sampling assessment will normally consist of a general site evaluation, pre-sampling activities, sampling activities, and an exit interview. Each of these elements will be discussed in detail in the succeeding paragraphs. It should be noted that the inspection checklist (O&M SOP Attachment D) is to be completed during the inspection process to ensure that specific items are addressed and specific information is obtained. Also, note that split-samples should be collected according to the facility Sampling and Analysis Plan to maintain consistency with the facility protocol. However, where applicable, the inspector should implement appropriate SOP procedures.

3.1 GENERAL SITE EVALUATION.

The inspector must conduct a general evaluation of the site to provide information and/or indications of actual or potential releases of hazardous waste. The specific details will depend on the type of regulated unit(s), but the following items should be observed:

a. Evidence of leakage through impoundment dikes or landfill covers

b. Evidence of seepage; e.g., damp or wet spots or pools of standing liquid, absent, dead or dying vegetation in isolated areas, unusually lush vegetation growth, aquatic vegetation growth in perennial seeps.

c. Evidence of impoundment overflowing; e.g., insufficient freeboard, dikes, and/or areas downstream denuded of vegetation, erosion of dikes and/or downstream areas.

d. Vegetation stress; e.g., dead or dying trees and other vegetation over general area that may indicate the invasion of the unsaturated zone by contaminants.

e. Excessive erosion through landfill covers, of impoundment dikes, and from active portions of land treatment facilities.

f. Slope instability and/or failures in impoundment dikes and landfill trench excavations.

g. Surface water degradation.

Any of the above features that are observed during the course of the inspection should be photographed and described in the inspection report.

3.2 PRE-SAMPLING ACTIVITIES

This portion of the inspection includes verification of the monitoring well locations, observation of the monitoring wells, observation of water level measurements and evacuation purging procedures, and making measurements of water levels and well depths. The pre-sampling activities to consider are:

a. Monitoring well descriptions - All monitoring wells should be visually inspected and the components described including the following:

   1. Well casing material type and diameter

   2. Condition of surface seal

   3. Protective casing

   4. Security measures

b. Monitoring well locations - The locations of all the monitoring wells should be verified for correctness.

c. Static water level measurements - Prior to pre-sampling evacuation of each well, the water level in the well must be determined by actual measurement. The measurements should be to the nearest 0.01 foot. It is usually required by the KDHE approved SAP that the measurements be taken on all of the wells prior to any purging. In order to evaluate the adequacy of the measurements, the inspector should:

1. Observe the procedures used to make these measurements and note the type of water level measurement device used.

2. Make an independent water level measurement at a minimum of ten percent of the monitoring wells utilizing KDHE equipment or facility provided equipment for comparison.

3. Determine if reference elevations of the ground surface at the well or at the top of the well casings have been established by a reliable survey to the nearest 0.01 foot.

4. Determine the adequacy of the decontamination procedure. The parts of the water level measurement device that enter the well casing during use must be thoroughly cleaned and decontaminated between wells to avoid cross-contamination. The KDHE approved SAP may require the measurements to be made sequentially from the non-contaminated or least contaminated well to the most contaminated well.

5. Determine the adequacy of the maintenance and calibration procedures for the water level measurement device.

d. Well depths/sediment accumulation - Well depths should be measured by sounding the bottoms with a weighted stainless steel measuring tape or other suitable measuring device. The differences in as-built depths and measured depths generally indicate sediment accumulation possibly resulting from improperly designed and/or constructed wells. Properly designed and constructed wells contain graded filter pack materials and well screens with openings sized to preclude sediment accumulation.

e. Evacuation of monitoring wells - The purpose of well evacuation prior to sample withdrawal is to remove stagnant water that may not be representative of in situ groundwater quality. Historically, the general rule held that three to five casing volumes should be evacuated and the well should be allowed to recover prior to sampling. However, low flow and no purge methods may have been approved; therefore, the KDHE approved SAP must be followed closely. The inspector will observe the evacuation procedures and record the following information:

1. Type of evacuation equipment and types of materials of which it is constructed including delivery lines or lines used to lower equipment into the well.

2. Whether or not wells are completely evacuated, and, if so, the number of times they are evacuated.

3. Intake depth for pump inlet diffusion bag or other.

4. Volumes evacuated from wells.

5. Methods used to determine volumes evacuated or other purging criteria including purge parameter measurements.

6. Procedures for collection, management and disposal of evacuated water.

7. Whether or not individual wells have dedicated evacuation equipment.

8. Decontamination procedures for equipment used in more than one well.

9. Physical properties of evacuated water; i.e., color, odor, turbidity, and presence of oil and grease.

3.3 SAMPLING ACTIVITIES

This portion of the inspection includes observing sampling procedures, obtaining split samples for comparative analyses and performing field measurements.

a. Sample withdrawal - The major consideration for sample withdrawal procedures is insuring that samples are not altered or contaminated during the process. Sampling equipment must be constructed of materials compatible with actual or potential contaminants. These materials must neither leach nor absorb constituents of interest. Sampling equipment must be dedicated to individual wells or be capable of being fully disassembled and cleaned between wells. Lines used to lower equipment into the well and discharge piping must also be constructed of materials compatible with contaminants. Sample withdrawal may be accomplished with bailers or pumps. Bailers are simple to operate, inexpensive, require no external power source, and may be constructed from any of a variety of materials compatible with the parameters of interest. Pumps are available in a wide variety of types and may or may not be suitable for particular monitoring well sample withdrawal operations. The inspector will observe sample withdrawal and record the following information:

   1. Type of sampling device.

   2. Type of materials of which sampling device, lowering lines and discharge piping are constructed.

   3. Depths at which samples are recovered.

4. Whether or not sampling equipment is dedicated to individual wells.

5. Decontamination procedures for equipment used in more than one well.

6. Whether or not samples are withdrawn and collected to minimize absorption, agitation and volatilization.

7. Physical characteristics of samples; e.g., color, odor, turbidity, and presence of oil and grease.

8. Sequence of sampling wells.

b. Sample containers/preservation - The type of sample container used for each parameter to be analyzed must be made of materials compatible with the parameter. The preservation of the samples for specific parameters must be in accordance with established procedures. At a minimum, the inspector should document the sample containers and preservatives used for each constituent to be analyzed for.

c. Field measurements - The inspector should observe the procedures used by the facility sampling crew to perform instantaneous measurements in the field; e.g., pH, specific conductance and temperature. In regard to field measurements performed by the facility sampling crew, the inspector should insure that the analytical method is an accepted procedure for the parameter determined and is performed in an acceptable manner. The type of field instrument utilized and the adequacy of the calibration and maintenance procedures should also be noted. All of the results obtained by the facility from field determinations should be recorded.

d. Split samples - The inspector should obtain split samples from the predetermined number of wells for analyses of all parameters. The specific procedures on how the samples are split should be noted.

e. Decontamination - Equipment and/or equipment components used in well measurements, well evacuation, or sample withdrawal should be decontaminated between wells to preclude contamination and/or cross-contamination of wells. The inspector should observe and record the decontamination procedures. In addition, to avoid the inadvertent contamination of the equipment, it should not be permitted to come in contact with the ground after cleaning or prior to use. It is recommended that some type of protective sheeting (plywood or polyethylene) be placed on the ground for use as the work surface for sampling and measurement operations.

f. Documentation - The facility should maintain documents to adequately record information obtained during a groundwater monitoring sampling event. The inspector should review and evaluate the documents utilized by the facility for completeness and consistency with the sampling and analysis plan. Copies of the specific documents should be obtained for inclusion with the final report. Specific chain of custody procedures and documentation should adequately provide for a record tracing the possession and handling of individual samples from the time of collection through laboratory analysis and a mechanism to preserve the integrity of individual samples.

g. Sample Analysis - The facility should analyze the sample or have the sample analyzed by a private laboratory in accordance with KDHE approved analytical methods for each parameter. One method should be specified for each parameter in the facility's sampling and analysis plan. KDHE will determine the adequacy of the analytical methods used. If the samples are sent to a private laboratory for analyses, the inspector should obtain information about shipment, analytical methods, etc., to insure that proper procedures are followed. The name and address of the private laboratory should be recorded.

h. Quality assurance - The inspector should evaluate the adequacy of the quality control/quality assurance procedures incorporated into the sampling event. Specifically, the facility should include field blanks, duplicate samples and other quality control samples.

3.4 EXIT CONFERENCE

Upon completion of all the tasks involved in the groundwater sampling event, an exit conference should be held with the facility representatives as a means of providing them with a summary of the preliminary findings of the O&M inspection. The inspector should accomplish the following actions during the exit conference or briefing:

a. Critique the facility's field measurement and sampling procedures, documentation, and other issues pertinent to the groundwater monitoring process.

b. Specific technical recommendations should be presented as a means of enhancing the quality of the facility's program. Consistency of procedures should be the emphasis.

c. Any specific regulatory requirements not being met by the facility should be discussed, but it should be pointed out that additional compliance issues may result from further evaluation of the observations and procedures following the inspection.

d. A mechanism for obtaining the facility's analytical results from the sampling event should be established. All of the raw analytical data from the analyses of the field samples, and quality control samples should be obtained in order to completely evaluate the quality of the results. In addition, if not obtained during the inspection, all of the results from the field measurements should be obtained.

ATTACHMENT F

Example Operation and Maintenance Report Table of Contents

ATTACHMENT G

Summary of Regulations Related to Operation and Maintenance Programs

(Adapted from OSWER 9950-3 O&M Inspection Guide)

Interim Status	Description
265.15(b)(l)	"The owner or operator must develop and follow a written schedule for inspecting all monitoring equipment,... and operating and structural equipment... that are important to preventing, detecting, or responding to environmental or human health hazards."
265.15(b)(2)	"The owner or operator must keep this schedule at the facility."
265.15(b)(3)	"The schedule must identify the types of problems (e.g. malfunctions or deterioration) which are to be looked for during the inspection..."
265.15(b)(4)	"The frequency of inspection...should be based on the rate of possible deterioration of the equipment...."
265.15(d)	"The owner or operator must record inspections in an inspection log or summary. He must keep these records for at least three years from the date of inspection. At a minimum, these records must include the date and time of inspection, the name of the inspector, a notation of the observations made, and the date and nature of any repairs or other remedial actions."
265.73(a)	"The owner or operator must keep a written operating record at the facility."
265.73(b)	"The following information must be recorded, as it becomes available, and maintained in the operating record until closure of the facility:..." (5) "Records and results of inspections..." (6) "Monitoring, testing, or analytical data..."
265.74(a)	"All records, including plans, required under this part must be furnished upon request, and made available at reasonable times for inspection by any officer, employee, or representative of EPA who is duly designated by the Administratror"
265.90(a)	"...the owner or operator of a surface impoundment, landfill, or land treatment facility…must implement a ground-water monitoring program capable of determining the facility's impact on the quality of groundwater in the uppermost aquifer..."
265.92(a)	"The owner or operator must obtain and analyze samples from the installed ground-water monitoring system. The owner or operator must develop and follow a ground-water sampling and analysis plan..." "...The plan must include procedures and techniques for: (1) Sample collection; (2) Sample preservation and shipment; (3) Analytical procedures; and (4) Chain of custody control.

Interim Status	Description
265.94(a)(1)	“[The owner or operator must] keep records of the received analyses..., the associated ground-water surface elevations...”
265.94(a)(2)	“[The owner or operator must] report the following ground-water monitoring information to the Regional Administrator:” [annual reports of required ground-water monitoring results including ground-water elevation data].

Permit Status	Description
264.15(a)	“The owner or operator must inspect the facility for malfunctions and deterioration, operator errors, and discharges...”
264.15(b)(l)	“The owner or operator must develop and follow a written schedule for inspecting monitoring equipment, safety and emergency equipment, security devices, and operating and structural equipment...”
264.15(b)(2)	“The owner or operator must keep this schedule at the facility.”
264.15(b)(3)	“The schedule must identify the types of problems (e.g. malfunctions or deterioration) which are to be looked for during the inspection. …”
264.15(b)(4)	“The frequency of inspection-should be based on the rate or possible deterioration or the equipment.” “The owner or operator must record inspections in an inspection log or summary. He must keep these records for at least three years from the date of the inspection. At a minimum, these records must include the date and time of the inspection, the name of the inspector, a notation of the observations made, and the date and nature of any repairs or other remedial actions.”
264.73(a)	“The owner or operator must keep a written operating record at the facility.”
264.73(b)	‘The following information must be recorded, as it becomes available, and maintained in the operating record until closure of the facility: “(5) Records and results of inspections... “(6) Monitoring, testing, or analytical data…”
264.74(a)	“All records, including plans, required under this part must be furnished upon request and ma& available at reasonable times for inspection....”
264.77(c)	“[The owner or operator must report to the Regional Administrator] As... required by Subpart F...”

Permit Status	Description
264,97(a)(2)	“[The ground-water monitoring system must] represent the quality of groundwater passing the point of compliance.”
264.97(d)	“The ground-water monitoring program must include consistent sampling and analysis procedures that arc &signed to ensure monitoring results that provide a reliable indication of groundwater quality below the waste management area. At a minimum, the program must include procedures and techniques for: (1) Sample collection; (2) Sample preservation and shipment; (3) Analytical procedures; and (4) Chain of custody control.”
264.97(e)	“The ground-water monitoring program must include sampling and analytical methods that are appropriate for groundwater sampling and that accurately measure hazardous constituents in ground-water samples.”
264.97(f)	“The ground-water monitoring program must include a determination of the groundwater surface elevation each time ground-water is sampled.”
264.98(f)(2)	“The owner or operator must determine whether statistically significant evidence of contamination at each monitoring well as the compliance point....
264.98(e)	“‘The owner or operator must determine the ground-water flow rate and direction in the uppermost aquifer at least annually
264.99(d)(2)	“The owner or operator must determine whether statistically significant evidence of increased contamination at each monitoring well at the compliance point....
264.99(e)	‘The owner or operator must determine the ground-water flow rate and direction in the uppermost aquifer at least annually
264.100(g)	“The owner or operator must report in writing to the Regional Administrator on the effectiveness of the corrective action program. The owner or operator must submit these reports annually.”
264.100(d)	“In conjunction with a corrective action program, the owner or operator must establish and implement a ground-water monitoring program to demonstrate the effectiveness of the corrective action program. Such a monitoring program may be based on the requirement for a compliance monitoring program under §264.99...”
Permit Status	**Description**

270.30(e)	“Proper operation and maintenance. The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training,...”
270.30(h)	“The permittee shall furnish....within a reasonable time... copies of records required to be kept by this permit.”
270.30(i)(2)	“Inspection and entry. The permittee shall allow the Director...to...have access to and copy, at reasonable times... any records that must be kept under the conditions of this permit.”
270.30(j)(1)	“Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity.”
270.30(j)(2)	“The permittee shall retain records of all monitoring information, including all calibration and maintenance records,... copies of all reports required by this permit,...for a period of at least three years from the date of the sample....” “The permittee shall maintain records from all ground-water monitoring wells and associated ground-water surface elevations for the active life of the facility, and for disposal facilities for the post-closure care period as well.”
270.30(j)(3)	“Records for monitoring information shall include: (i) The date, exact place, and time of sampling or measurements; (ii) The individual(s) who performed the sampling or measurements; (iii) The date(s) analyses were performed; (iv) The individual(s) who performed the analyses; (v) The analytical techniques or methods used; and (vi) The results of such analyses.”
270.30(k)(1)(1)	“Planned changes. The permittee shall give notice to the Director as soon as possible of any planned physical alterations or additions to the permitted facility.”
270.30(k) (l)(4)	“Monitoring efforts. Monitoring results shall be reported at the intervals specified elsewhere in this permit”

ATTACHMENT H

Technical Inadequacies to Look for in a Ground Water Operation and Maintenance Inspection

This table illustrates examples of observations that may constitute noncompliance on the part of the owner/operator. The project manager should apply this table in determining if a violation is warranted on a site-specific basis.

CATEGORY OF VIOLATION	EXAMPLE OBSERVATIONS[1]	EXAMPLE DOCUMENTATION FOR RCRAINFO[2]
Improper maintenance of groundwater monitoring wells	Wells not properly marked with ID number or surveyed reference mark	264.97(c), 265.91(c), K.A.R. 28-31-1 Failure to maintain integrity of well [well cap missing].
	Well caps missing	
	Well pads damaged, covered with vegetation, or have animal burrows present.	
	Well performance, capacity, or groundwater quality has changed (doesn't recharge, evidence of biofouling)	
	Well casings damaged	
	Wells are silted in or total depth deeper than original depth	
	Wells in network are not surveyed to the same benchmark or survey data is missing	264.97(f), 265.92(d), K.A.R. 28-31-1 Failure to properly determine groundwater surface elevation [Wells not surveyed to same benchmark].
Inadequate operation and maintenance program	Failure to develop an inventory of sampling devices/equipment including operation manuals, serial and model numbers	264.15(b), 265.15(b), K.A.R. 28-31-1 Failure to perform adequate operation and maintenance activities [Criteria for redevelopment of wells not included in SAP].
	Failure to develop operating, calibration, and maintenance procedures for sampling devices/equipment	
	Failure to provide criteria for repairing/replacing equipment	
	Failure to provide criteria for redeveloping/replacing wells	
	Failure to develop procedures for assessing degradation of well casings	
	Failure to maintain schedule for operation and maintenance activities	
	Failure to assess groundwater flow rate and directions on annual basis	264.98(e)/264.99(e), 265.93(f)/265.94(a), K.A.R. 28-31-1 Failure to assess groundwater flow rate and/or direction properly [Unacceptable potentiometric maps submitted].
	Unacceptable groundwater potentiometric surface maps	

[1] While these example observations have been commonly observed at Kansas sites over the years, this does not constitute a complete list of possible observations.

[2] Regulatory authority for permitted status violations - 40 CFR 264 Subpart F and G
Regulatory authority for Interim status violations - 40 CFR 265 Subpart F and G
Regulatory authority for violations of State Orders - K.A.R. 28-31-1

CATEGORY OF VIOLATION	EXAMPLE OBSERVATIONS[1]	EXAMPLE DOCUMENTATION FOR RCRAINFO[2]
Sampling crew not following sampling and analysis plan and/or permit conditions for collecting groundwater samples.	Improper decontamination of equipment	264.97(d), 265.92(a), K.A.R. 28-31-1 Failure to follow specified procedures for collecting groundwater samples [Improper equipment decontamination].
	Improper purge methods (not purging enough volume, not allowing parameters to stabilize)	
	Improper collection of static water levels (SWLs)	
	No trip, field, or equipment blanks collected	
	Samples not collected within 24 hours of purging	
	Using improper sampling devices, sample bottles, or preservation, or collection techniques	
	Improper handling of samples (not eliminating head space, agitating bailer samples)	
	Improper chain-of-custody procedures	
	Lab analysis not completed by a laboratory certified by the State of Kansas.	K.A.R. 28-31-8(f)
Operating record incomplete	Incomplete operating record kept on-site (see Attachment B for checklist)	264.73(a) & (b), 265.73(a) & (b), K.A.R. 28-31-1 Failure to maintain operating record [Records not available during inspection].
	Improper documentation on field forms	
	Inability to produce operating record during inspection	264.74(a), 265.74(a), K.A.R. 28-31-1 Failure to produce operating record during inspection.
Inadequate general post-closure care	Failure to maintain waste containment systems (leachate collection)	264.117(a), (b) & (c); 265.117(a), (b) & (c), K.A.R. 28-31-1 Failure to perform general post-closure requirements [cap shows evidence of erosion].

[1] While these example observations have been commonly observed at Kansas sites over the years, this does not constitute a complete list of possible observations.

[2] Regulatory authority for permitted status violations - 40 CFR 264 Subpart F and G
Regulatory authority for Interim status violations - 40 CFR 265 Subpart F and G
Regulatory authority for violations of State Orders - K.A.R. 28-31-1

STANDARD OPERATING PROCEDURE BWM-011

GUIDELINES FOR CONDUCTING a COMPREHENSIVE GROUNDWATER MONITORING EVALUATION (CME)

TABLE OF CONTENTS

Concurrences and Approvals

Concurrences: Bureau of Waste Management

Name: Jim Rudeen
Title: Chief, Compliance, Assistance, and Enforcement Section

Signature Jim Rude Date 2-4-11

Name: Dennis Degner
Title: Chief, Solid Waste Permits Section

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Signature William L Bider Date 2-4-11

Approvals: Division of Environment

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Name: John Mitchell
Title: Director, Division of Environment

Signature John W Mitchell Date 2-10-11

SOP No. BWM-011

STANDARD OPERATING PROCEDURE for a COMPREHENSIVE GROUNDWATER MONITORING EVALUATION (CME)

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to establish uniform procedures for performing a Comprehensive Groundwater Monitoring Evaluation (CME) at RCRA regulated facilities. A CME is required for the evaluation of a facility's RCRA compliance with 40 CFR, Parts 264 and 265 Subparts F, and 40 CFR 270.

2.0 INTRODUCTION

A comprehensive groundwater monitoring evaluation (CME) determines whether an owner or operator has in place a groundwater monitoring system that is adequately designed, operated, and maintained to detect releases or to define the rate and extent of contaminant migration from a RCRA unit where groundwater monitoring is required. Specifically, a CME is intended to assess:

a. The adequacy of the information on which the design of the groundwater monitoring system is based;
b. The adequacy of the groundwater monitoring system's design and construction; and
c. The adequacy of the groundwater monitoring system's operation

3.0 GENERAL GUIDANCE

A CME is comprised of two major components: an Operation and Maintenance (O&M) inspection and a Hydrogeologic Assessment (HGA).

a. The Operation and Maintenance (O&M) inspection evaluates how an owner or operator of a facility operates and maintains its RCRA groundwater monitoring system. Guidance for performing an O&M inspection may be found in the Standard Operating Procedure for Groundwater Monitoring System Operation and Maintenance (O&M) inspection document.

b. A Hydrogeologic Assessment (HGA) addresses the adequacy of the groundwater monitoring system's design and construction. The guide for performing such an assessment is described in detail in Attachment A. This assessment is an in-depth technical evaluation to determine the adequacy of the groundwater monitoring system. Due to the nature of this evaluation, qualified professionals with expertise in geology and/or hydrogeology must be involved to adequately perform these assessments.

The combined product of these two components results in the overall comprehensive groundwater evaluation of a facility's groundwater monitoring system and provides the basis for determining the compliance status and for developing future enforcement strategies to correct deficiencies. The actual end product of the CME process is a narrative report that summarizes the results of the O&M inspection and HGA, and it consolidates all of the information into one package for use by permits and/or compliance personnel. The final CME report will identify the deficiencies of the groundwater monitoring system in meeting regulatory requirements and will list them in such a manner that the specific items can be incorporated directly into subsequent compliance orders if necessary. In addition to this SOP, a number of guidance documents from EPA are available online or in the BWM library for assistance in performing a CME (EPA's 1986 Draft Technical Enforcement Guidance Document (TEGD) is a very important reference), and referring to such guidance within the CME report is encouraged. For guidance on structuring a CME report, refer to Attachment B for an example of a KDHE final CME report outline.

Within 30 days of performing the inspection, the project manager needs to send a letter conveying preliminary findings of the inspection to the facility. At this time the RCRAInfo database is to be updated to list that the inspection was performed on the date of the field visit. The project manager should list any deficiencies that are included in the preliminary findings on the CMEL form, but should also indicate on the form that additional deficiencies may be determined prior to finalizing the report. Deficiencies that are clearly inconsistent with a regulation or a KDHE approved plan will be considered to be violations, and KDHE needs to communicate with the facility and schedule a date for the facility's return to compliance. The tables in Attachment C are provided to assist the project manager in determining whether violations of applicable regulations exist; however, in addition to violations, the inspector occasionally notices conditions for which citing a violation is not warranted, but the facility should improve upon to avoid future problems. For each deficiency that is not a violation, KDHE should give a written recommendation to correct the deficiency. For this second type of deficiency, the information needs to be listed on RCRAInfo, but only in the comments section, not under violations. Professional judgment will be necessary to a limited degree to distinguish between the types of deficiencies.

By the end of August of the fiscal year, a copy of the draft report will be sent to the EPA and a copy of the draft report will be sent to the facility (Any mention of deficiencies will be left absent in the facility's copy of the draft report.) for a thirty-day review period. Following the draft review period, the project manager will revise the draft CME report as necessary based on comments received, and prepare the final CME report. By the end of September, the project manager will have completed and sent the final CME report to the facility. A copy will be placed on file, another copy will be sent to the EPA. KDHE's cover letter to the facility will emphasize correction of those deficiencies within a specified time period. The project manager will take necessary steps to update the RCRAInfo database to list any deficiencies. The project manager will subsequently log onto RCRAInfo to verify that the data shows up as intended. Finally, as deficiencies are corrected, the project manager must ensure the database gets further updates as needed.

ATTACHMENT A

GUIDANCE and CHECKLISTS for CONDUCTING a HYDROGEOLOGIC ASSESSMENT of GROUNDWATER MONITORING SYSTEMS in COMPREHENSIVE MONITORING EVALUATIONS (CME)

1.0 PURPOSE

The purpose of this guidance is to support the standard operating procedure (SOP) for a comprehensive monitoring evaluation (CME) in conducting and reporting hydrogeologic assessments (HGAs) of groundwater monitoring systems at facilities regulated under RCRA.

2.0 INTRODUCTION

A hydrogeologic assessment (HGA) is a portion of the comprehensive monitoring evaluation (CME) process to determine the adequacy of a facility's groundwater monitoring system in meeting the requirements of RCRA. The HGA is an in-depth technical evaluation of the ground water monitoring system and therefore, qualified professionals with expertise in the areas of geology and/or hydrology are needed for its completion. This document has been compiled as a guide in order to assure completeness, accuracy and consistency in conducting and reporting HGAs. Specifically, this document is intended to provide sufficient guidance to the technical personnel who conduct HGAs so they will know:

- What information must be accumulated and included in the final report.
- What descriptions and summaries must be forwarded and included in the final report.
- What technical evaluations must be accomplished and addressed in the final report.
- What recommendations, as appropriate, must be developed and incorporated in the final report.
- What constitutes a complete technical evaluation.

Due to the complexity of the issues addressed during an HGA, specific guidance regarding many of the highly technical issues is beyond the scope of this assessment. This document should be used in conjunction with two versions of RCRA Groundwater Monitoring Technical Enforcement Guidance Document (draft), U.S. EPA, both September 1986 and November 1992.

The ultimate purpose of the HGA is to determine the adequacy of a facility's groundwater monitoring system (either installed or proposed) in meeting the regulatory requirements of 40 CFR Part 265, 270 and/or 264, as applicable. To this end, an HGA focuses on evaluating the adequacy of the information on which the monitoring system was based, and on the actual design and construction of the system.

3.0 SPECIFIC POLICIES

The ultimate goal of the CME process is to insure that all of the corresponding groundwater monitoring systems at all facilities in Kansas are in compliance with the regulatory requirements of 40 CFR 264, 265 and/or 270, as applicable. To this end, all corresponding facilities with groundwater monitoring systems within Kansas will be evaluated as to adequacy through the CME process. The following specific policies will apply to all HGAs performed:

a) All in-place (installed monitoring systems, either for detection or assessment monitoring, will be evaluated based on their intended purpose. If a facility has both detection and assessment monitoring systems, the systems will be evaluated independently; i.e., a determination of adequacy of each system will be made.

b) For facilities with interim status and in assessment monitoring, any proposed groundwater quality assessment monitoring system (whether or not they have been previously approved and/or are under construction) will be evaluated independently of in-place detection monitoring system(s).

c) For facilities with no in-place monitoring system, the technical assessment will consist of an evaluation which is as in-depth as the available data will allow. If a closure plan has been submitted and it contains a proposed groundwater monitoring system, the proposed system will be evaluated as to adequacy based on the technical assessment.

d) Any outline of a groundwater quality assessment program submitted in accordance with 40 CFR 265.93(a) will be evaluated based on the criteria contained in 265.93(a) (1)-(3).

e) For facilities that have submitted Part B permit applications, the review of a proposed monitoring program pursuant to 40 CFR 270.14(c) will be conducted as part of the permit application review process. If the permit application review process is underway and the review of a proposed monitoring system has been completed, the review should be utilized as a source document during the technical assessment.

4.0 INFORMATION ACCUMULATION

The initial step in the HGA process is the accumulation of information regarding the facility from a variety of sources. The accumulated information will be reviewed, categorized, interpreted, evaluated and assembled throughout the entire process and will be used as the basis for making technical decisions, conclusions and recommendations. Specific information should be obtained about the facility relating to the past and present operations, basis for the monitoring system design, final monitoring system design, construction, and performance. This site-specific information will normally be obtained from such sources as the facility itself, EPA files and KDHE files.

Although by no means complete, the following information should be accumulated:

- Processes that produce waste(s)

- Nature and volumes of the waste(s) produced
- Past and present treatment, storage and/or disposal practices of the waste(s)
- History of the regulated unit(s); e.g., date(s) installed, expanded and/or modified; types of waste(s) managed in each unit; any releases, etc.
- Site maps
- Subsurface hydrology and geology including any drilling logs
- Topography (past and/or present)
- Man-made features which might affect groundwater flow
- Regional information collected by the owner/operator
- Previous studies of hydrology and geology
- Design and studies of existing monitoring wells
- Laboratory results of any soil/rock samples during drilling operations
- Piezometer readings and water elevation measurements of wells
- Laboratory results of monitoring well samples
- Surveys

Specific information should be obtained from other sources (such as USGS, Kansas Geological Survey, U.S. Army Corps of Engineers, etc.) to augment the site-specific information obtained from or about the facility. Examples of commonly available information are:

- USGS topographic maps
- Aerial photos
- Hydrogeologic information
- Regional geologic studies and information
- Well logs from water wells or other borings in the area around the facility

In order to obtain all information necessary to complete the evaluation, it is anticipated that at least one site visit will be required. The purpose and scope of the site visit will depend on the complexity of the facility and the availability of information about the site.

5.0 EVALUATION PROCESS

Since there are numerous factors that will greatly influence the evaluation process, there is no simple step-by-step approach that can be presented for conducting an HGA. Instead, the evaluation process is presented in terms of the specific elements that need to be considered.

In order for the evaluation to be complete and consistent, these items need to be assessed in detail. To assist in the evaluation process, three worksheets, which are attached, will be used to insure that all appropriate items are assessed. The worksheets are titled "Characterization of Site Hydrogeology Worksheet," "Placement of Monitoring Wells Worksheet," and "Monitoring Well Design and Construction Worksheet."

A discussion of each element of the HGA is presented in more detail below:

a) Regulated unit(s) - A description of the regulated unit(s) at the facility which is(are) subject to the RCRA groundwater monitoring requirements will be obtained during the evaluation, An accurate site map showing the actual location(s) of the regulated unit(s) will also be obtained. In addition, the specific regulatory requirements (detection, assessment or permit requirements), which apply to each regulatory unit, will be determined.

b) Information utilized by the owner/operator - The adequacy of the information, which was utilized by the owner/operator as the basis for the monitoring system design, will be evaluated. Specifically, the evaluation of the adequacy of the owner/operator's information should answer the following two questions:

   - Did the owner/operator collect enough information to: 1) have an understanding sufficient to identify potential contamination pathways, and; 2) support the placement of wells capable of determining the facility's impact on the uppermost aquifer?

   - Did the owner/operator use appropriate techniques to collect and interpret the information used to support well placement?

   The project manager should specifically review the information that the owner/operator relied on in designing the monitoring system and insure that the owner/operator properly interpreted and used the information. The project manager should develop his own interpretations of the data in order to make a comparison of the owner/operator's interpretation. Data interpretation techniques described in the TEGD may be used in this process. The project manager must make a clear determination as to the adequacy of the interpretation of the data, and to the adequacy of the use of the data in designing the monitoring system.

Most of the hydrogeologic assessment involves the evaluation of the information collected and used by the owner/operator, and the development of independent interpretations of the available information for comparing to and determining the adequacy of the owner/operator's interpretation of the data.

c) Characterization of the subsurface geology - In order to adequately define the subsurface geology of the site, the first step toward designing a monitoring system, the owner/operator should have performed a detailed investigation to identify the lithology and structural characteristics of the subsurface using direct methods supplemented by indirect methods. The project manager will review the investigatory techniques used by the owner/operator to insure that they were adequate to define the subsurface geology of the site. The investigation must include the following direct techniques as a minimum:

- Soil borings
- Survey of existing geologic information
- Material tests (grain size analyses, standard penetration test, etc.)

At a minimum, the soil boring program must include:

- Some borings at a spacing no greater than 300 feet. Subsequent borings may be spaced farther apart if the results of initial borings spaced 300 feet apart indicate a subsurface geology of sufficient uniformity to justify the greater spacing. It may also be justified to perform the initial borings spaced greater than 300 feet. Whichever the case, the justification for greater spacing must be thoroughly evaluated to insure it is valid.
- Several borings that are drilled to bedrock.
- Continuous sample cores logged by a qualified geologist for a sufficient fraction of the total borings. The project manager will determine whether or not a sufficient fraction was accomplished during the review and evaluation process.
- Accurate and complete boring logs that present all relevant data collected during the drilling process.

The project manager should also interpret the data generated to compare with the interpretation obtained by the owner/operator to insure that the site has been accurately characterized. This can be accomplished by evaluating the presentations of the data generated from the investigation. The preferred methods for data presentation are:

- Narrative description of geology
- Geologic cross sections

- Geologic or soil map
- Boring logs
- Raw data and interpretive analysis of material tests.

d) Identification of groundwater pathways - As part of the hydrogeologic investigation conducted to characterize the site, the owner/operator must also adequately identify groundwater flow paths in addition to characterizing the subsurface geology. The project manager will review the investigatory techniques to insure they were adequate to accurately identify the groundwater flow paths. In order to adequately identify the groundwater flow paths, the owner/operator must have:

  - Established the direction of groundwater flow including both horizontal and vertical components of flow. (The project manager must give careful consideration to the need to examine the vertical component of flow during the evaluation process, because in some cases this aspect may not be needed.);
  - Established the seasonal, temporal and artificially induced (i.e., off-site production well pumping, agricultural use) variations in groundwater flow; and
  - Determined the hydraulic conductivities of the hydrogeologic units underlying the site.

  At a minimum, the following direct techniques must have been included in the investigation:

  - Installation of piezometers; water level measurements at different depths.
  - Slug test and/or pump test.

  The project manager should also interpret the data generated to compare with the interpretation obtained by the owner/operator to insure the groundwater flow paths under the site have been accurately identified. This should be accomplished by evaluating the presentations of the data generated from the investigation. The preferred methods for data presentation are:

  - Narrative description of groundwater with flow patterns
  - Water table or potentiometric maps (plain view) with flow lines
  - Hydrogeologic cross section.

e) Identification of uppermost aquifer, including connected aquifers - Since the owner/operator is required to monitor the uppermost aquifer, the adequacy of the owner/operator's identification of the uppermost aquifer must be evaluated. In addition, a determination of whether or not the owner/operator understands the definition of the uppermost aquifer is inherent to this evaluation. The following five tasks should be accomplished during this evaluation:

- Determine (either explicitly or implicitly), if possible, the definition of the uppermost aquifer that the owner/operator used in designing the monitoring system.
- Examine and assess the adequacy of the information the owner/operator relied on in identifying the uppermost aquifer.
- Examine and judge the correctness of the information owner/operator relied on in identifying the uppermost aquifer.
- Examine and judge the correctness of the owner/operator's identification of the uppermost aquifer.
- Independently identify, if possible, the uppermost aquifer.

f) Design and placement of monitoring wells - The adequacy of the decisions made by the owner/operator regarding the number and locations of monitoring wells is crucial to determining whether or not the monitoring system is adequate and meets the requirements of the regulations; i.e., the key determination of the HGA. It is critical that this determination and the basis for it (both factual and professional judgment) be explained in detail.

1) Upgradient well(s) - The following specific tasks regarding upgradient well(s) will be accomplished:

   - Examine the owner/operator's rationale for placement and design of the upgradient well(s) and judge the adequacy of the well(s), either installed or proposed.
   - Independently determine, if possible, the appropriate location(s) and design parameters of the upgradient well(s) at the facility.
   - Identify any additional hydrogeologic investigations that should be required before appropriate locations and design parameters can be accurately specified for upgradient wells at the facility.

   The following questions should be answered regarding upgradient wells during this evaluation:

   - Has the owner/operator located background wells far enough away from waste management areas to prevent contamination from the facility?

- Has the owner/operator installed enough wells, screened at appropriate depths, to adequately account for spatial variability in background water quality?

During this evaluation, the project manager should consider or determine the following:

- It is possible that one well is adequate for a particular facility, but it is unusual. It will be left to the professional judgment of the individual conducting the HGA to determine the adequacy of the number and location.

- In most cases, depending on the type of statistical method used, the owner/operator should install 2 to 4 background monitoring wells in order to determine spatial variability for statistical analyses of background water quality.

- The upgradient well(s) should be screened at depths that correspond to the sampling points (geologic formations) in the downgradient wells.

- It will not usually be acceptable for the owner/operator to screen upgradient wells over the entire thickness of the uppermost aquifer. Ten-foot screens are recommended by the TEGD, but appropriate screen lengths will be left to the judgment of the individual conducting the HGA.

- It should be determined whether or not the upgradient well(s) are in fact upgradient and secure from contamination by the unit(s) being monitored.

2) Downgradient wells - The evaluation of the placement and design of the downgradient wells (either installed or proposed) will be accomplished based on the purpose of the monitoring system (detection or assessment) and thus compared to the regulatory requirements.

   The following specific tasks regarding downgradient wells will be accomplished:

   - Examine the owner/operator's rationale for the placement and design of the downgradient wells and judge the adequacy of the wells, either installed or proposed.

   - Independently determine, if possible, the appropriate locations and design parameters for the downgradient wells at the facility.

   - Identify any additional hydrogeologic investigations that should be required before appropriate locations and design parameters can be accurately specified for the downgradient wells at the facility.

The following specific items regarding downgradient wells will be evaluated as to adequacy based on professional judgment and guidance contained in the TEGD:

- Number of wells - In most cases, three downgradient wells are not enough. Only in the simplest of geologic settings with very shallow water bearing layers above bedrock and a very small regulated unit, could three downgradient wells be considered sufficient. The evaluation must include the determination of the adequacy or inadequacy of the number of downgradient wells.

- Spacing of wells - The adequacy of the spacing of the downgradient wells will be determined based on the recommended distance of 150 feet as contained in the TEGD. The project manager must relate any deviations from this benchmark criteria listed in the TEGD in order to ultimately determine the adequacy or inadequacy of the spacing of the downgradient wells.

- Location of wells - The placement of the downgradient wells must be evaluated in terms of their location relative to the regulated unit(s) and of their intended purpose; i.e., detection/compliance, or assessment/corrective action monitoring. For detection/compliance monitoring, the wells should be placed as near as practical to the regulated unit(s). How close must be determined by the project manager. For assessment/corrective action monitoring, the wells should be placed in order to determine the rate and extent of migration of hazardous waste and hazardous waste constituents in the groundwater and evaluate the effectiveness of the corrective action as applicable. The adequacy of the assessment/corrective action monitoring system relative to these criteria must be determined.

- Use of cluster wells - Based on the scenario of the site, the need for and use of cluster wells should be evaluated in regard to adequately monitoring the groundwater downgradient of the regulated unit(s). A determination of the adequacy or inadequacy of the use of cluster wells, either in place or proposed, must be made.

- Construction materials - The adequacy of the materials used in the construction of the wells will be judged in terms of the affect of the materials on the quality of groundwater samples (such as sorbing, leaching and reacting with groundwater) and long-term structural integrity of the materials.

- Screen length - The adequacy of screen length in the downgradient wells will be determined based on the recommended length of 10 feet as contained in the TEGD. Based on the geologic setting and other site characterization factors, a determination as to the adequacy of the screen length must be made.

- Depth of screen interval - The adequacy of the screen interval depth must be determined based on site-specific conditions to insure that the wells will adequately monitor the stratigraphic horizons most likely to serve as contaminant pathways.

Details of the groundwater monitoring system should be obtained and summarized for inclusion with the final report. At a minimum, the monitoring wells should be located on the site map, individual drilling logs should be obtained, if possible, and the construction details of each well should be obtained.

6.0 REPORTING

The final report of the HGA will consist of a narrative and attachments to provide a complete description and evaluation of the groundwater monitoring system at a facility. The narrative portion will address all of the specific items evaluated and will provide overall summary conclusions. The following specific items will be addressed under appropriately titled sections of the report:

- Description of facility including operations, processes and products
- Description/locations of regulated unit(s) managing hazardous wastes and subject to groundwater monitoring
- Owner/operator information
- Characterization of subsurface geology of site and region
- Identification of groundwater pathways
- Identification of uppermost aquifer
- Placement of monitoring wells
- Description/location of monitoring system (in-place or proposed)

Specific conclusions regarding the adequacy of supporting data/information and data and of the monitoring well system will be stated. The following standardized summary conclusions will be utilized to summarize the hydrogeologic assessment and will be supported by discussions within the body of the report:

- For detection/compliance monitoring systems, one of the following conclusions should be reached based on the consideration and evaluation of all available information:
- The design and construction of the groundwater monitoring system <u>are</u> adequate to ensure that it will immediately detect any release from any of regulated units;
- The design and construction of the groundwater monitoring system <u>are not</u> adequate to ensure that it will immediately detect any release from the regulated units; or,
- The available information is not adequate to assess the adequacy of the design and construction of the groundwater monitoring system, and, therefore, the system is assumed to be inadequate.

For assessment/corrective action monitoring systems, one of the following conclusions should be reached based on the consideration and evaluation of all available information:

- The design and construction of the groundwater monitoring system <u>are</u> adequate to ensure that it will determine the rate and extent of migration of hazardous waste or hazardous waste constituents in the groundwater and the effectiveness of the corrective action as applicable.

- The design and construction of the groundwater monitoring system <u>are not</u> adequate to ensure that it will determine the rate and extent of migration of hazardous waste or hazardous waste constituents in the groundwater and the effectiveness of the corrective action as applicable.

- The available information is not adequate to assess the adequacy of the design and construction of the groundwater monitoring system, and, therefore, the system is assumed to be inadequate.

The specific attachments included with the report will depend on the complexity of the facility and the need for information to support the narrative discussions. In addition, specific attachments will be used to document that the guidance contained in the TEGD has been addressed during the evaluation.

The following documents are required to be included as attachments to the report:

- Site map showing the location(s) of regulated unit(s)

- All information relating to the hydrogeology of the site and regarding the design and performance of the groundwater monitoring system

- Site map showing the locations of the monitoring wells

- Drilling logs, if available

- Construction details of the monitoring wells

- Completed evaluation worksheets (see Attached)

Additional attachments may be included at the discretion of the project manager to support narrative discussions.

CHARACTERIZATION OF SITE HYDROGEOLOGY WORKSHEET

The following worksheets have been designed to assist the project manager in evaluating the program the owner/operator used in characterizing hydrogeologic conditions at the site. This series of worksheets have been compiled to parallel the information presented in Chapter 1 of the TEGD.

A.	REVIEW OF SITE HYDROGEOLOGIC INVESTIGATION TECHNIQUES

		YES	NO
A.1.	Did a Kansas Licensed Geologist perform the site investigation/data collection?__________	☐	☐
A.2.	Did the owner/operator survey the following regional data:		
	1. U.S.G.S. Maps? __________	☐	☐
	2. Water supply well logs? __________	☐	☐
	3. Other (specify) __________		
A.3.	Did the owner/operator use the following direct techniques in the hydrogeologic assessment?		
	1. Soil borings/rock cores? __________	☐	☐
	2. Materials test; e.g., grain size analyses, standard penetration test, etc.?__________	☐	☐
	3. Piezometer installation for water level measurements at different depths? __________	☐	☐
	4. Slug tests? __________	☐	☐
	5. Pump test? __________	☐	☐
	6. Geochemical analyses of soil samples?__________	☐	☐
	7. Other (specify): __________		

Give a brief evaluation of the information.____________________

____

____

____

		YES	NO
A.4.	Did the owner/operator use the following indirect techniques to supplement direct technique data:		
	1. Geophysical well logs? __________	☐	☐
	2. Tracer studies?__________	☐	☐
	3. Resistivity and/or electromagnetic conductance?__________	☐	☐
	4. Seismic Survey?__________	☐	☐
	5. Hydraulic conductivity measurements of cores?__________	☐	☐
	6. Aerial photography? __________	☐	☐
	7. Ground penetrating radar? __________	☐	☐
	8. Other (specify) __________		

Give a brief evaluation of the information.____________________

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		YES	NO
A.5.	Did the owner/operator document and present the raw data from the site hydrogeologic assessment?__________	☐	☐
A.6.	Did the owner/operator document methods (criteria) used to correlate and analyze the information?__________	☐	☐

		YES	NO
A.7.	Did the owner/operator prepare the following:		
	1. Narrative description of geology?	☐	☐
	2. Geologic cross sections?	☐	☐
	3. Geologic and soil maps?	☐	☐
	4. Boring/coring logs?	☐	☐
	5. Structure contour maps of aquifer and aquitard?	☐	☐
	6. Narrative description of groundwater flows?	☐	☐
	7. Water table/potentiometric map?	☐	☐
	8. Hydrologic cross sections?	☐	☐
	Give a brief evaluation of the information. ______		
A.8.	Did the owner/operator obtain a regional map of the area and delineate the facility?	☐	☐
A.9.	If yes, does this map illustrate:		
	1. Surficial geology features?	☐	☐
	2. Streams, rivers, lakes, or wetlands near the facility?	☐	☐
	3. Discharging or recharging wells near the facility?	☐	☐
A.10.	Did the owner/operator obtain a regional hydrogeologic map?	☐	☐
A.11.	If yes, does this hydrogeologic map indicate:		
	1. Major areas of recharge/discharge?	☐	☐
	2. Regional groundwater flow direction?	☐	☐
	3. Potentiometric contours which are consistent with observed water level elevations?	☐	☐
	Give a brief evaluation of the information. ______		
A.12.	Did the owner/operator prepare a facility site map?	☐	☐
A.13.	If yes, does the site map show:		
	1. Regulated units of facility (e.g., landfill areas, impoundments)?	☐	☐
	2. Any seeps, springs, streams, ponds, or wetlands?	☐	☐
	3. Location of monitoring wells, soil borings, or test pits?	☐	☐
	4. How many regulated units does the facility have? ______		
	If more than one regulated unit then,		
	Does the waste management area encompass all regulated unites?	☐	☐
	Is a waste management area delineated for each regulated unit?	☐	☐
	Give a brief evaluation of the information. ______		

B.	CHARACTERIZATION OF SUBSURFACE GEOLOGY OF THE SITE

YES NO

B.1. Soil boring/test pit program:

1. Were the soil borings/test pits performed under the supervision of a qualified professional? ☐ ☐
2. Were the borings placed 300 feet apart? ☐ ☐
3. If not, did the owner /operator provide documentation for selecting the spacing for borings? ☐ ☐
4. Were the borings drilled to the depth of the first confining unit below the uppermost zone ☐ ☐ of saturation or ten feet into bedrock? ☐ ☐

Give a brief evaluation of the information.

5. Indicate the method(s) of drilling:

   - Auger (hollow or solid stem) ☐ ☐
   - Mud rotary ☐ ☐
   - Air rotary ☐ ☐
   - Reverse rotary ☐ ☐
   - Cable tool ☐ ☐
   - Jetting ☐ ☐
   - Other (specify)

6. Were continuous sample cores taken? ☐ ☐

7. How were the samples obtained?
   - Split Spoon ☐ ☐
   - Shelby tube ☐ ☐
   - Rock coring ☐ ☐
   - Ditch sampling ☐ ☐
   - Other (specify)

8. Were the continuous sample cores logged by a qualified geologist? ☐ ☐

Give a brief evaluation of the information.

9. Does the field boring log include the following information:

   - Hole name/Number? ☐ ☐
   - Date started and finished? ☐ ☐
   - Geologist's name? ☐ ☐
   - Driller's name? ☐ ☐
   - Hole location (i.e., map and elevation)? ☐ ☐
   - Drill rig type and bit/auger size? ☐ ☐
   - Gross petrography (e.g., rock type of each geologic unit? ☐ ☐
   - Gross mineralogy of each geologic unit? ☐ ☐

	YES	NO
Gross structural interpretation of each geologic unit and structural features (e.g., fractures, gouge material, solution channels, buried streams or Valleys, identification of depositional material)? ______	☐	☐
Development of soil zones and vertical extent and description of soil type? ______	☐	☐
Depth of water bearing unit(s) and vertical extent of each? ______	☐	☐
Depth and reason for termination of borehole? ______	☐	☐
Depth and location of any contaminant encountered in borehole? ______	☐	☐
Sample location/number? ______	☐	☐
Percent sample recovery? ______	☐	☐
Narrative descriptions of		
Geologic observations? ______	☐	☐
Drilling Observations? ______	☐	☐

Give a brief evaluation of the information. ______________________________

10. Were the following analytical tests performed on the core samples:

	YES	NO
Mineralogy (e.g., microscopic test and x-ray diffraction)? ______	☐	☐
Petrographic analysis:		
Degree of crystallinity and cementation of matrix? ______	☐	☐
Degree of sorting, size fraction (i.e., sieving), textural variations? ______	☐	☐
Rock type(s)? ______	☐	☐
Soil type? ______	☐	☐
Approximate bulk geochemistry? ______	☐	☐
Existence of microstructures that may effect or indicate fluid flow? ______	☐	☐
Falling head test? ______	☐	☐
Static head tests? ______	☐	☐
Settling measurements? ______	☐	☐
Centrifuge tests? ______	☐	☐
Column drawings? ______	☐	☐

Give a brief evaluation of the information. ______________________________

B.2. Verification of subsurface geological data

	YES	NO
1. Has the owner/operator used indirect geophysical methods to supplement geological conditions between borehole locations? ______	☐	☐
2. Does the number of borings and analytical data indicate that the confining layer displays a low enough permeability to impede the migration of contaminants to any stratigraphically lower water-bearing units? ______	☐	☐
3. Is the confining layer laterally continuous across the entire site? ______	☐	☐
4. Did the owner/operator consider the chemical compatibility of the site-specific waste types and the geologic materials of the confining layers? ______	☐	☐
5. Did the geologic assessment address or provide means for resolution of any information gaps or geologic data? ______	☐	☐

		YES	NO
6.	Does the laboratory data corroborate the field data for petrography?	☐	☐
7.	Does the laboratory data corroborate the field data for mineralogy and subsurface geochemistry?	☐	☐

Give a brief evaluation of the information. ______

B.3. Presentation of geologic data

		YES	NO
1.	Did the owner/operator present at least four geologic cross sections of the site?	☐	☐
2.	Do each of these cross sections:		
	Identify the types and characteristics of the geologic materials present?	☐	☐
	Define the contact zones between different geologic materials?	☐	☐
	Note the zones of high permeability or fracture?	☐	☐
	Give detailed borehole information including:		
	Location of borehole?	☐	☐
	Depth of termination?	☐	☐
	Location of screen (if applicable)?	☐	☐
	Depth of zone of saturation?	☐	☐
3.	Did the owner/operator provide a topographic map?	☐	☐
4.	Does the topographic map provide:		
	Contours at a maximum interval of two-feet?	☐	☐
	Locations and illustrations of man-made features (e.g., parking lots,	☐	☐
	Factory buildings, drainage ditches, storm drains, pipelines, etc.)?	☐	☐
	Descriptions of nearby water bodies?	☐	☐
	Ddescriptions of off-site wells?	☐	☐
	Site boundaries?	☐	☐
	Individual RCRA units?	☐	☐
	Delineation of the waste management area(s)?	☐	☐
	Well and boring locations?	☐	☐
5.	Did the owner/operator provide an aerial photograph depicting the site and adjacent off-site features?	☐	☐
6.	Does the photograph clearly show surface water bodies, adjacent municipalities, and residences and are these clearly labeled?	☐	☐

Give a brief evaluation of the information. ______

C.	IDENTIFICATION OF GROUNDWATER FLOWPATHS

		YES	NO
C.1.	Groundwater flow direction		
1.	Was the well casing height measured by a licensed surveyor to the nearest 0.01 feet?	☐	☐
2.	Were the well water level measurements taken within a 24-hour period?	☐	☐
3.	Were the well water level measurements taken to the nearest .01 feet?	☐	☐
4.	Were the well water levels allowed to stabilize after construction and development for a minimum of 24 hours prior to measurements?	☐	☐
5.	Was the water level information obtained from (check appropriate one):		
	Multiple piezometers placement in single boreholes?	☐	☐
	Vertically nested piezometers in closely spaced separate boreholes?	☐	☐
6.	Did the owner/operator provide construction detail for the piezometers?	☐	☐
7.	How were the static water levels measured (check method(s).		
	Electric water sounder	☐	☐
	Air line	☐	☐
	Other (explain)		
8.	Was the well water level measured in wells drilled to an equivalent depth below the saturated zone, or screened at an equivalent depth below the saturated zone?	☐	☐
9.	Has the owner/operator provided a site water table (potentiometric) contour map?	☐	☐
	If yes,		
	do the potentiometric contours appear logical based on topography and presented data? (consult water level data)	☐	☐
	are groundwater flowlines indicated?	☐	☐
	are static water levels shown?	☐	☐
	can hydraulic gradients be estimated?	☐	☐
10.	Did the owner/operator develop two, or more, hydrogeologic cross sections of the vertical flow component across the site?	☐	☐
11.	Do the owner/operator's flow nets include:		
	piezometer locations?	☐	☐
	depth of screening?	☐	☐
	width of screening?	☐	☐

Give a brief evaluation of the information. ____
____
____
____

		YES	NO
C.2.	Seasonal and temporal fluctuations in groundwater level		
1.	Do fluctuations in static water levels occur?	☐	☐
	If yes, are the fluctuations caused by any of the following:		
	off-site well pumping	☐	☐
	tidal processes or other intermittent natural variations (e.g., river stage, etc)	☐	☐

	YES	NO
on-site well pumping	☐	☐
off-site, on-site construction or changing land use patterns	☐	☐
deep well injection	☐	☐
seasonal variations	☐	☐
other (specify)________		
2. Has the owner/operator documented the source and patterns that contribute to or affect the groundwater flow below the waste management area?	☐	☐
3. Do the water level fluctuations alter the general groundwater gradients and flow directions?	☐	☐
4. Based on water level data, do any head differentials occur that may indicate a vertical flow component in the saturated zone?	☐	☐
5. Did the owner/operator implement means for gauging long term effects on water movement that may result from on-site or off-site construction or changes in land-use patterns?	☐	☐

Give a brief evaluation of the information.____________________

C.3. Hydraulic conductivity

	YES	NO
1. How were hydraulic conductivities of the subsurface materials determined?		
Single-well test (slug test)?	☐	☐
Multiple-well test (pump test)?	☐	☐
2. If a single-well test was conducted, was it done by adding or removing a known volume of water?	☐	☐
3. If a single well test was conducted in highly permeable formation, was a pressure transducer and high-speed recording equipment used to record the rapidly changing water levels?	☐	☐
4. Since single well tests only measure hydraulic conductivity in a limited area, were enough tests run to ensure a representative measure of conductivity in each hydrogeologic unit?	☐	☐
5. Is the owner/operator's slug test data (if applicable) consistent with existing geologic information (e.g., boring logs)?	☐	☐
6. Were other hydraulic conductivity properties determined?	☐	☐

7. If yes, provide any of the following data, if available:

Transmissivity ________
Storage coefficient________
Leakage________
Permeability________
Porosity ________
Specific capacity ________
Other (specify)________

Give a brief evaluation of the information.____________________

___

		YES	NO
C.4.	Identification of the uppermost aquifer		
	1. Has the extent of the uppermost saturated zone (aquifer) in the facility area been defined? ___	☐	☐
	If yes, Are soil boring/test pit logs included? ___	☐	☐
	Are geologic cross-sections included? ___	☐	☐
	2. Is there evidence of confining (competent, unfractured, continuous, and low permeability) layers beneath the site? ___	☐	☐
	If yes, Was continuity demonstrated through the evidence of lack of drawdown in the upper well when separate, closely-spaced wells (one screened at the uppermost part of the water table, and the other screened on the lower side of the confining layer) are pumped simultaneously? ___	☐	☐
	3. Was hydraulic conductivity of the confining unit determined to be less than 10^{-7} cm/sec by field test? ___	☐	☐
	4. Does potential for other hydraulic interconnection exist (e.g., lateral incontinuity between geologic units, facies changes, fracture zones, cross cutting structures, or chemical corrosion/alteration of geologic units by leachate)? ___	☐	☐

Give a brief evaluation of the information. ___

___

___

___

D.	CONCLUSIONS

		YES	NO
D.1.	Subsurface geology ___		
	1. Has the subsurface geochemistry been adequately defined? ___	☐	☐
	2. Was the boring/coring program adequate to define subsurface geologic variation? ___	☐	☐
	3. Was the owner/operator’s narrative description complete and accurate in its interpretation of the data? ___	☐	☐
	4. Does the geologic assessment address or provide means to resolve any information gaps? ___	☐	☐

Evaluate the completeness and adequacy of the information presented. ___

___

___

___

		YES	NO
D.2.	Groundwater flowpaths		
	1. Did the owner/operator adequately establish the horizontal and vertical components of groundwater flow? ___	☐	☐
	2. Were appropriate methods used to establish groundwater flowpaths? ___	☐	☐
	3. Did the owner/operator provide accurate documentation? ___	☐	☐
	4. Are the potentiometric surface measurements valid? ___	☐	☐

	YES	NO
5. Did the owner/operator adequately consider the seasonal and temporal effects on the groundwater? ___	☐	☐
6. Were sufficient hydraulic conductivity tests performed to document lateral and vertical variation in hydraulic conductivity below the site? ___	☐	☐

Evaluate the completeness and adequacy of the information presented. ___

D.3. Uppermost aquifer

	YES	NO
1. Did the owner/operator adequately define the uppermost aquifer? ___	☐	☐

Evaluate the completeness and adequacy of the information presented. ___

PLACEMENT OF DETECTION MONITORING WELLS WORKSHEET

The following worksheets are designed to assist the project manager's evaluation of an owner/operator's approach for selecting the number, location, and depth of all detection phase monitoring wells. This series of worksheets has been compiled to closely track the information presented in Chapter 2 of the TEGD. The guide for the evaluation of an owner/operator's placement of monitoring wells is highly dependent upon a thorough characterization of the site hydrogeology as described in Chapter 1 of the TEGD and Appendix A.1 worksheets.

A.	PLACEMENT OF DOWNGRADIENT DETECTION

YES NO

A.1. Are the groundwater monitoring wells or clusters located immediately adjacent to the waste management area? ______ ☐ ☐

A.2. How far apart (i.e., what is the spacing?) between detection monitoring well locations? ______

______

______

A.3. Does the owner/operator provide a rationale for the location of each monitoring well or cluster? ______ ☐ ☐

A.4. Did the owner/operator provide an explanation for the spacing of the groundwater monitoring wells? ______ ☐ ☐

A.5. Has the owner/operator identified the vertical sampling interval(s) of each monitoring well or cluster, i.e., depth and thickness? ______ ☐ ☐

A.6. Does the owner/operator provide an explanation for the depth and thickness of the vertical sampling interval(s) for each monitoring well or cluster? ______ ☐ ☐

A.7. What length screens has the owner/operator employed in the groundwater monitoring wells on site? ______

______

______

A.8. Does the owner/operator provide an explanation for the screen length(s) chosen? ______ ☐ ☐

A.9. Do the actual locations of monitoring wells or clusters correspond to those identified by the owner/operator? ______ ☐ ☐

Give brief evaluation of information ______

______

______

______

B.	PLACEMENT OF UPGRADIENT MONITORING WELLS

YES NO

B.1. Has the owner/operator documented the location of each upgradient monitoring well or cluster? ______ ☐ ☐

YES NO

B.2. Does the owner/operator provide an explanation for the location(s) of the upgradient monitoring wells? ______ ☐ ☐

B.3. Has the owner/operator provided a rationale for the depth and thickness of the vertical sampling interval for each background monitoring well or cluster? ______ ☐ ☐

B.4. What length screens has the owner/operator employed in the background monitoring well(s)?_

______
______
______

B.5. Does the owner/operator provide an explanation for the screen length(s) chosen? ______ ☐ ☐

B.6. Does the actual location of each background monitoring well or cluster correspond to that identified by the owner/operator? ______ ☐ ☐

Give a brief evaluation of the information.______

______
______
______
______

C.	CONCLUSIONS

YES NO

C.1. Downgradient Wells

Do the location spacing, and vertical sampling interval(s) of the groundwater monitoring wells or clusters in the ground water monitoring system allow the immediate detection of a release of hazardous waste or constituents from the hazardous waste management area to the uppermost aquifer? ______ ☐ ☐

If in assessment/corrective action monitoring, does the ground water monitoring system provide data sufficient to determine the extent of contamination and determine the effectiveness of corrective action activities? ______ ☐ ☐

Evaluate the completeness and adequacy of the information present ______

______
______
______

YES NO

C.2. Upgradient Wells

Do the location and vertical sampling interval(s) of the upgradient (background) groundwater monitoring wells ensure the capability of collection groundwater samples representative of upgradient (background) groundwater quality including any ambient heterogeneous chemical characteristics? ____________________ ☐ ☐

Evaluate the completeness and adequacy of the information present ____________________
____
____
____

MONITORING WELL DESIGN AND CONSTRUCTION WORKSHEET

The following worksheets have been designed to assist the inspector in evaluation the techniques used by an owner/operator for designing and constructing monitoring wells. This series of worksheets has been compiled to parallel the information presented in Chapter 3 of the TEGD.

Complete the attached well construction summary sheet for each of the monitoring wells, unless similar documentation is already available from the owner/operator. Include the locations where the well intercepts changes in geological formation.

A.	DRILLING METHODS

		YES	NO
A.1.	What drilling method was used for the well?		
	Hollow-stem auger ______	☐	☐
	Solid-stem auger ______	☐	☐
	Mud rotary ______	☐	☐
	Air rotary ______	☐	☐
	Reverse rotary ______	☐	☐
	Cable tool ______	☐	☐
	Jetting ______	☐	☐
	Air drill with casing hammer ______	☐	☐
	Other (specify) ______		
A.2.	Were any cutting fluids (including water) or additives used during drilling? ______	☐	☐
	If yes, specify:		
	Type of drilling fluid ______		
	Source of water use ______		
	Foam ______		
	Polymers ______		
	Other ______		
A.3.	Was the cutting fluid, or additive, analyzed? ______	☐	☐
A.4.	Was the drilling equipment steam-cleaned prior to drilling the well? ______	☐	☐
A.5.	Was compressed air used during drilling? ______	☐	☐
	If yes, was the air treated to remove oil (e.g., filtered)? ______	☐	☐
A.6.	Did the owner/operator document the procedure used for establishing depth and slope of the water table? ______	☐	☐
	If yes, how was the location established? ______		
	______		
	______		
	______		

YES NO

A.7. Formation samples

1. Were continuous formation sample cores collected during drilling? ______ ☐ ☐
2. How were the samples obtained?
   - Split spoon ______ ☐ ☐
   - Shelby tube ______ ☐ ☐
   - Core drill ______ ☐ ☐
   - Other (specify) ______
3. Indicate the frequency at which formation samples were collected ______
4. Identify if any physical and/or chemical tests were performed on the formation samples (specify) ______

Give a brief evaluation of the information. ______

B.	MONITORING WELL CONSTRUCTION MATERIALS

YES NO

B.1. Identify construction materials and diameters (ID/OD)	Material	Diameter (ID/OD)
1. Primary Casing	______	______
2. Secondary or outside casing (double construction)	______	______
3. Screen	______	______

B.2. How are the sections of casing and screen connected?
- Pipe sections threaded ______ ☐ ☐
- Couplings (friction) with adhesive or solvent ______ ☐ ☐
- Couplings (friction) with retainer screws ______ ☐ ☐
- Other (specify) ______

B.3. Were the materials steam-cleaned prior to installation? ______ ☐ ☐

Give a brief evaluation of the information. ______

C.	WELL INTAKE DESIGN AND WELL DEVELOPMENT

YES NO

C.1. Was a well intake screen installed? ______ ☐ ☐
1. What is the length of the screen for the well? ______
2. Is the screen manufactured (instead of casing that was perforated by hand)? ______ ☐ ☐

C.2. Was filter pack installed? ☐ ☐
Has a turbidity measurement of the well water ever been made? ☐ ☐

C.3. Well development
What technique was used for well development?
Surge block ☐ ☐
Bailer ☐ ☐
Air surging ☐ ☐
Water pumping ☐ ☐
Other (specify) ____

Give a brief evaluation of the information. ____

D.	ANNULAR SPACE SEALS

YES NO

D.1. 1. What is the annular space in the saturated zone directly above the filter pack filled with?

Sodium bentonite (specify type) ____
Cement (specify neat or concrete) ____
Other (specify) ____

2. Was the seal installed by?
Dropping material down the open borehole and tamping ____
Dropping material down the inside of hollow-stem auger ____
Tremie pipe method ____
Other (specify) ____

D.2. Was a different seal used in the unsaturated zone? ☐ ☐

1. If yes, was this seal made with?
Sodium bentonite (specify type) ☐ ☐
Cement (specify neat or concrete) ☐ ☐
Other (specify) ☐ ☐
2. Was this seal installed by?
Dropping material down the hole and tamping ☐ ☐
Dropping material down the inside of hollow-stem auger ☐ ☐
Tremie pipe method ☐ ☐
Other (specify) ____

D.3. Is the upper portion of the borehole sealed with a concrete cap/pad/apron to prevent infiltration from the surface? ☐ ☐

Give a brief evaluation of the information. ____

ATTACHMENT B

CME REPORT OUTLINE

EXECUTIVE SUMMARY

1.0 INTRODUCTION

2.0 FACILITY DESCRIPTION
- 2.1 Facility Description
- 2.2 Regulatory Status and History
- 2.3 Waste Management Unit(s)

3.0 HYDROGEOLOGIC SETTING
- 3.1 Summary of Efforts to Characterize Geology and Hydrogeology
- 3.2 Summary of Regional and Local Geology
- 3.3 Summary of Regional and Local Hydrogeology
- 3.4 Brief Conceptual Model of Ground Water Flow Including KDHE Comments and Concerns

4.0 GROUNDWATER MONITORING SYSTEM
- 4.1 Historical Development of Monitoring, Contamination, and Remediation
- 4.2 Detailed Description of Current System for Ground Water Monitoring and Remediation, Including KDHE Comments and Concerns

5.0 OPERATION AND MAINTENANCE INSPECTION
- 5.1 Participants
- 5.2 KDHE Comments on Sampling and Analysis Plan
- 5.3 KDHE Comments on Monitoring Well integrity
- 5.4 KDHE Comments on Groundwater Elevation and Total Depth Measurements
- 5.5 KDHE Comments on Monitoring Well Purging Procedures
- 5.6 KDHE Comments on Monitoring Well Sampling Procedures
- 5.7 KDHE Comments on Equipment Decontamination
- 5.8 KDHE Comments on Quality Assurance and Quality Control

6.0 DATA ANALYSIS
- 6.1 Statistical Analysis of Groundwater Quality Data
- 6.2 KDHE Comments on Data, Validation, and Reporting

7.0 CONCLUSIONS
- 7.1 KDHE Evaluation of Findings Including a Discussion of Past Deficiencies
- 7.2 Required Actions Based on KDHE Evaluation

FIGURES

Facility Location Map
Regulated Unit and Well Location Map
KDHE Groundwater Potentiometric Surface Map
Facility Groundwater Potentiometric Surface Map
Geologic Cross Section(s)
Geologic Map
Contaminant Plume Map
Other figures as needed

TABLES

Comparison of Measured Total Well Depths to Original Total Well Depths
Comparison of KDHE and Facility Analytical Data
Monitoring Well Construction Details
Other tables as needed

APPENDICES

Regulatory History from KDHE Files
RCRA Operation and Maintenance Inspection Checklist
Characterization of Site Hydrogeology Worksheet
Facility Records of Field Activities
Facility Groundwater Analytical Data
KDHE Groundwater Analytical Data
Photographs of Inspection

ATTACHMENT C

LIST OF TECHNICAL INADEQUACIES THAT MAY CONSTITUTE VIOLATIONS

(Adapted from OSWER 9950.2 CME Inspection Guide)

This table illustrates examples of situations that may constitute noncompliance on the part of the owner/operator. The enforcement official should apply this table in determining if a violation is warranted on a site-specific basis.

Regulatory Objectives	Examples of Technical Inadequacies That May Constitute Violations	Regulatory Citations
1. Uppermost Aquifer must be correctly identified.	• Failure to consider aquifers hydraulically interconnected to the uppermost aquifer	265.90(a) 265.91(a)(1) & (a)(2) 270.14(c)(2)
	• Incorrect identification of certain formations as confining layers or aquitards • Failure to use test drilling and/or soil borings to characterize subsurface hydrogeology	265.90(a) 295.91(a)(1) & (a)(2) 270.14(c)(2)
2. Ground-water flow directions and rates must be properly determined.	• Failure to use piezometers or wells to determine ground-water flow rates and directions (or failure to use a sufficient number of them)	265.90(a) 295.91(a)(1) & (a)(2) 270.14(c)(2)
	• Failure to consider temporal variations in water levels when establishing water flow directions (e.g. seasonal variations, short-term fluctuations due to pumping)	290.90(a) 295.91(a)(1) & (a)(2) 270.14(c)(2)
	• Failure to assess significance of vertical gradients when evaluating flow rates and directions.	265.90(a) 295.91(a)(1) & (a)(2) 270.14(c)(2)
	• Failure to use standard/consistent benchmarks when establishing water level elevations.	265.90(a) 265.91(a)(1)
	• Failure of the O/O to consider effect of local with drawl wells on ground-water flow direction	265.90(a) 265.91(a)(1)
	• Failure of the O/O to obtain sufficient water level measurement	265.90(a) 265.91(a)(1)

Regulatory Objectives	Examples of Technical Inadequacies That May Constitute Violations	Regulatory Citations
3. Background wells must be located so as to yield samples that are not affected by the facility.	• Failure of the O/O to consider the effect of local withdrawal wells on ground-water flow	265.90(a) 265.91(a)(1)
	• Failure of the O/O to obtain sufficient water level measurements	265.90(a) 265.91(a)(1)
	• Failure of the O/O to consider flow path of dense immiscibles in establishing up-gradient well locations	265.90(a) 265.91(a)(1)
4. Background wells must be constructed so as to yield samples that are representative of in-situ ground-water quality.	• Wells constructed of materials that may release or sorb constituents of concerns	265.90(a) 265.91(a)
	• Wells improperly sealed-contamination of sample is a concern	265.90(a) 265.91(a) 265.91(c)
	• Nested or multiple screen wells are used and it cannot be demonstrated that there has been no movement of ground water between strata	265.90(a) 265.91(a)(1) 265.91(a)(2)
	• Improper drilling methods were used, possibly contaminating the formation	265.90(a) 265.91(a)
	• Well intake packed with materials that may contaminate sample	265.90(a) 265.91(a) 265.91(c)

Regulatory Objectives	**Examples of Technical Inadequacies That May Constitute Violations**	**Regulatory Citations**
Background wells must be constructed so as to yield samples that are representative of in-situ ground-water quality. (continued)	• Well screens used are of an inappropriate length	265.90(a) 265.91(a)(1) 265.91(a)(2)
	• Wells developed using water other than formation water	265.90(a) 265.91(a)
	• Improper well development yielding samples with suspended sediments that may bias chemical analysis	265.90(a) 265.91(a)
	• Use of drilling muds or non-formation water during well construction that can bias results of samples collected from wells	265.90(a) 265.91(a)
5. Down-gradient monitoring wells must be located so as to ensure the immediate detection of any contamination migrating from the facility.	• Wells not placed immediately adjacent to waste management area	265.90(a) 265.91(a)(2)
	• Failure of O/O to consider potential pathways for dense immiscibles	265.90(a) 265.91(a)(2)
	• Inadequate vertical distribution of wells in thick or heavily stratified aquifer	265.90(a) 265.91(a)(2)
	• Inadequate horizontal distribution of wells in aquifers of varying hydraulic conductivity	265.90(a) 265.91(a)(2)
	• Likely pathways of contamination (e.g., buried stream channels, fractures, areas of high permeability) are not intersected by wells	265.90(a) 265.91(a)(2)
	• Well network covers uppermost but not interconnected aquifers	265.90(a) 265.91(a)(2)
6. Down-gradient monitoring wells must be constructed so as to yield samples that are representative of in-situ ground –water quality.	• See #4	

Regulatory Objectives	Examples of Technical Inadequacies That May Constitute Violations	Regulatory Citations
7. Samples from background and down-gradient wells collected and analyzed.	• Failure to evacuate stagnant water from the well before sampling	265.90(a) 265.92(a) 265.93(d)(4) 270.14(c)(4)
	• Failure to sample wells within a reasonable amount of time after well evacuation	265.90(a) 265.92(a) 265.93(d)(4) 270.14(c)(4)
	• Improper decisions regarding filtering or non-filtering of samples prior to analysis (e.g., use of filtration on samples to be analyzed for volatile organics)	265.90(a) 265.92(a) 265.93(d)(4) 270.14(c)(4)
	• Use of an inappropriate sampling device	265.90(a) 265.92(a) 265.93(d)(4) 270.14(c)(4)
	• Use of improper sample preservation techniques	265.90(a) 265.92(a) 265.93(d)(4) 270.14(c)(4)
	• Samples collected with a device that is constructed of materials that interfere with sample integrity	265.90(a) 265.92(a) 265.93(d)(4) 270.14(c)(4)
	• Sample collected with non-dedicated sampling dedicated sampling device is not cleaned between sampling events	265.90(a) 265.92(a) 265.93(d)(4) 270.14(c)(4)
	• Improper use of a sampling device such that sample quality is affected (e.g., degassing of sample caused by agitation of bailer)	265.90(a) 265.92(a) 265.93(d)(4) 270.14(c)(4)

Regulatory Objectives	Examples of Technical Inadequacies That May Constitute Violations	Regulatory Citations
Samples from background and down-gradient wells must be properly collected and analyzed. (continued)	• Improper handling of samples (e.g., failure to eliminate headspace from containers of samples to be analyzed for volatiles)	265.90(a) 265.92(a) 265.93(d)(4) 270.14(c)(4)
	• Failure of the sampling plan to establish procedures for sampling immiscibles (i.e., “floaters” and :sinkers”)	265.90(a) 265.92(a) 265.93(d)(4) 270.14(c)(4)
	• Failure to follow appropriate QA/QC procedures	265.90(a) 265.92(a) 265.93(d)(4) 270.14(c)(4)
	• Failure to ensure sample integrity through the use of proper chain-of-custody procedures	265.90(a) 265.92(a) 265.93(d)(4) 270.14(c)(4)
	• Failure to demonstrate suitability of methods used for sample analysis (other than those specified in SW-846)	265.90(a) 265.92(a) 265.93(d)(4) 270.14(c)(4)
	• Failure to perform analysis in the field on unstable parameters or constituents (e.g., pH, Eh, specific conductance, alkalinity, dissolve oxygen)	265.90(a) 265.92(a) 265.93(d)(4) 270.14(c)(4)
	• Use of sample containers that may interfere with sample quality (e.g., synthetic containers used with volatile samples)	265.90(a) 265.92(a) 265.93(d)(4) 270.14(c)(4)
	• Failure to make proper use of sample blanks	265.90(a) 265.92(a) 265.93(d)(4) 270.14(c)(4)

Regulatory Objectives	Examples of Technical Inadequacies That May Constitute Violations	Regulatory Citations
8. In part 265 assessment monitoring the O/O must sample for the correct substances.	• Failure of the O/O's list of sampling parameters to include certain wastes that are listed in 261.24 or 261.33, unless adequate justification is provided	265.93(d)(4)
	• Failure of the O/O's list of sampling parameters to include Appendix VII constituents of all wastes listed under 261.31 and 261.32, unless adequate justification is provided	265.93(d)(4)
9. In defining the Appendix VIII makeup of a plume, the O/O must sample for the correct substances.	• Failure of the O/O's list of sampling parameters to include all Appendix VIII constituents, unless adequate justification is provided	270.14(c)(4)
	• Failure of sampling effort to identify areas outside the plume	265.93(d)(4) 270.14(c)(4)
10. In Part 265 assessment monitoring and in defining the Appendix VIII makeup of a plume the O/O must use appropriate sampling methodologies.	• Number of wells was insufficient to determine vertical and horizontal gradients in contaminant concentrations	265.93(d)(4) 270.14(c)(4)
	• Total reliance on indirect methods to characterize plume (e.g., electrical resistivity, borehole geophysics)	265.93(d)(4) 270.14(c)(4)
	• Failure of O/O to implement a monitoring program that is capable of detecting the existence of any plume that might emanate from the facility	270.14(c)(4)
11. Part B applicants who have either detected contamination or failed to implement an adequate Part 265 GWM program must determine with confidence whether a plume exists and must characterize any plume.	• Failure of O/O to sample both up-gradient and down-gradient wells for all Appendix VIII constituents See also items #1, #2	270.14(c)(4)

STANDARD OPERATING PROCEDURE – BER-01

COLLECTION OF GROUNDWATER SAMPLES AT KNOWN OR SUSPECTED GROUNDWATER CONTAMINATION SITES

KANSAS DEPARTMENT OF HEALTH & ENVIRONMENT

KDHE

Effective Date: August 14, 2000
Revised Date: January 1, 2011

TABLE OF CONTENTS

DISCLAIMER:

This Standard Operating Procedure (SOP) was developed based on a compilation of best available information, knowledge, field experience, and general industry practices to provide guidance to KDHE staff in performing the activities defined herein, in a consistent and standardized manner. This document does not contain regulatory or statutory requirements unless specified.

KDHE has made every attempt to present the information in a clear and concise manner for a variety of users. However, KDHE is not responsible for the misuse or misinterpretation of the information presented herein. Under no circumstances shall KDHE be liable for any actions taken or omissions made by non-KDHE users of this document.

In general, this document should be used as a reference. Differences may exist between the procedures referenced in this document and what is appropriate under site-specific conditions. This document does not represent an endorsement of practitioners or products mentioned in the document.

1.0 INTRODUCTION

The purpose of this Standard Operating Procedure (SOP) is to provide general procedures and guidance for sampling groundwater wells using the well-volume method, the low-flow method, and no-purge methods for common contaminants of concern. Additional guidance is included for specific situations including collection of samples with volatile organic compounds (VOCs) and sites with low-yield wells. The objective of groundwater sampling is to obtain a representative sample by minimizing chemical and biological changes caused by sample collection and handling (USEPA, 2002). This SOP is generally applicable for contaminated sites in Kansas and is intended for wells that have a discrete screen length. Site-specific conditions or circumstances may necessitate the need to deviate from or use methods not outlined in this document subject to unit chief approval.

Each groundwater sampling method has inherent advantages and disadvantages that must be given consideration. An evaluation of site-specific factors is important in determining the appropriate sampling method for a well. These considerations can include, but may not be limited to: hydrogeological conditions, state or federal regulations, analytes of concern, well design, historical data, well development, well hydraulics, well condition, and data quality objectives when selecting appropriate sampling method (ASTM, 2005 and ASTM, 2007). Objectives for a groundwater well sampling program must be clearly defined before field implementation and the appropriate sampling method must be determined on a site-specific basis. The field sampling plan (FSP), quality assurance project plan (QAPP) and health and safety plan (HSP) must be reviewed prior to collection of any samples. Sampling devices selected should be constructed of materials that do not introduce contaminants or alter the target analytes (ASTM, 2007).

2.0 PRE-SAMPLING PROCEDURES

1. Start sampling at the least contaminated well, if known, and work to progressively more contaminated wells. The most contaminated well should be sampled last. If the contamination levels are not known, work from the most downgradient sampling location from the potential source area first, sampling closest to the potential source area last. If the direction of groundwater flow is unknown or uncertain, sampling should be initiated at the farthest distance away while progressively moving closer to the known or suspected source area.

2. Physical contact between sampling equipment and contaminated media should be minimized during well purging and sampling activities to avoid

contaminating the sampling equipment and/or groundwater. For example, bailers and pumps should not come in contact with soil or purge water containers. It may be appropriate to place plastic sheeting around the well to prevent direct contact of sampling equipment with the ground surface. A new pair of sampling gloves must be worn for each well prior to sampling to prevent cross-contamination.

3. Remove well cap to allow the groundwater level in the well to equilibrate with the ambient atmospheric pressure. Record well location, time of day, date, well condition, and other pertinent information in field notebook. Ideally, if more than one well is to be sampled at a site, all wells should be opened and have the depth to water measurements collected before purging and sampling activities begin.

4. When appropriate, screen the head-space of the well with a vapor monitoring instrument immediately after removal of the well cap to determine the presence of organic vapors and record the instrument response in site logbook.

5. Prior to placing any water level measuring device or reusable bailer in a well, care should be exercised to ensure that free floating immiscible product is not present in the well. Only properly decontaminated equipment should be introduced to the well. A disposable bailer may be lowered into the well to determine the approximate depth to water or depth to floating product. If floating product is observed, a groundwater sample should not be collected unless otherwise specified by a site-specific work plan. An interface probe or a partially submerged, clear PVC bailer should be used to measure the floating product thickness and the depth to water in the well. An attempt should be made to describe the type, color, and viscosity of the product.

6. Lower water level measuring device into well until water surface is encountered. Record the depth of the water surface from a specific reference point and record depth to water in field notebook to the nearest one hundredth of a foot. Water level measurement method and measurement reference point should also be recorded. Please refer to BER-36 titled. “Water Level, Product, and Well Depth Measurements.”

7. Measure total depth of well and record in site logbook or on log form. Total well depth should not be measured until after the sample is collected when using the no-purge sampling method.

3.0 SAMPLING USING THE WELL-VOLUME METHOD

3.1 DESCRIPTION OF WELL-VOLUME METHOD

The goal of well purging is to remove the stagnant water above the screened interval in order to collect a representative groundwater sample. The well-volume method is a traditional technique where a predetermined volume of water is removed from the well or water is removed from the well until specified parameters have stabilized before sample collection. This SOP outlines general procedures for purging and sampling using a fixed well-volume method. The stabilization well-volume method can be used to determine when a well has been adequately purged, but this specific method is not outlined in this SOP. Stabilization criteria for the stabilization well-volume method are similar to those outlined for low-flow sampling method, but specific stabilization criteria, measurement frequency, and other procedure requirements should be outlined in the site-specific work plan (USEPA, 2002).

Site-specific conditions and objectives should be considered before selecting this method since it may not be appropriate in conditions where there are low-yield wells, wells with higher turbidity, wells in fractured rock settings, wells with a set pump, or wells with separate phases of liquids (such as dense or light non-aqueous phase liquids) (USEPA, 2002). The advantages are that a variety of pumps can be used for purging or sampling and that it does not require chemical parameter measurements to determine when purging is complete. The disadvantages associated with the fixed well-volume method are that there may be an increased cost associated with handling a larger volume of investigative- derived waste (IDW) and that no well-specific analyte indicator or parameter used to determine when the well is adequately purged (ASTM, 2005). It is recommended that the stabilization method is used in most cases as this method commonly provides the most reliable data.

3.2 DETERMINATION OF PURGE VOLUME

A well is typically purged at least three to five well volumes (ASTM, 2007) and a fixed well volume purging is best applied to wells that yield multiple well volumes without fully dewatering the well (ASTM, 2005). The volume of water in the well, depth to water level, inner diameter of the well, the aquifer's recovery rate, accessibility to the well, and the contaminants being sampled have an effect on how a well should be purged and sampled. It is recommended that the same equipment used for purging also be used for sampling, unless the device is inappropriate for target analytes. A pump or bailer can be used to purge a well and it is preferable that equipment be constructed of an inert material (USEPA, 2002).

The volume of water in the well can be calculated by using information collected in pre-sampling activities (Section 2.0). The depth to water, total well depth, and inner well casing diameter are used in the following formula:

$$V = \pi r^2 h(cf)$$

where:
V = volume in gallons
π = pi or 3.1416
r = radius of monitoring well (feet); radius in inches/12 = radius in feet
h = height of the water column (feet), which equals the total well depth minus depth to water
cf = conversion factor (7.48 gal/ft^3)

Other variations of the basic formula for a cylinder can also be used to calculate the volume of water in a well. In most cases, it is appropriate to also purge the volume of water contained within a gravel pack and/or well borehole in addition to the well volume to assure that a representative sample is obtained.

For a 2 inch well: Volume = [(total depth – depth to water) * 0.16]
For a 4 inch well: Volume = [(total depth – depth to water) * 0.65]
For a 5 inch well: Volume = [(total depth – depth to water) * 1.03]
For a 6 inch well: Volume = [(total depth – depth to water) * 1.48]

Or calculate the volume using the following formula:
Volume = (total depth – depth to water)(casing inner diameter)^2(0.041)
Note: measurements are in feet

3.3 PURGING PROCEDURES FOR THE WELL-VOLUME METHOD

3.3.1 Purging with a Bailer

Bailers are a simple purging device and generally consist of a rigid length of tube constructed from PVC, stainless steel, or Teflon®, and usually with a ball check-valve at the bottom. A line is used to lower the bailer into the well to retrieve a volume of water. This manual method of purging is best suited for shallow or narrow diameter wells. Generally, bailers should be used if the well has a low recovery rate or if the amount of water to be purged is minimal (USEPA, 2002).

1. Complete the pre-sampling activities as outlined in Section 2.0.

2. Determine the appropriate purge water volume as described in Section 3.2.

3. Attach the line to the bailer and slowly lower the bailer until it is completely submerged in the water. Only dedicated, disposable, or properly decontaminated purge equipment should be introduced into the well. Over-disturbance of the water column in the well should be avoided. Carefully pull the bailer out to minimize disturbance of the well casing and water, and ensure that the line either falls onto a clean area of plastic sheeting or does not touch the ground. Empty the bailer into a bucket (of a known volume) to measure the volume of water purged.

4. Thereafter, continue with bailing process until desired purge volume has been removed. Record the total volume of water purged in field notebook.

5. Dispose of purged water as specified in the site-specific work plan.

6. If any bailer is being used at more than one well, it should be properly decontaminated prior to sampling the next well. New rope or string must be used at each location.

3.3.2 Purging with a Pump

Pump construction materials (bladders, pump, tubing) should be limited to stainless steel, Teflon, glass or other inert materials. A variety of pumps are available for purging wells. Please make sure that the pump utilized meets the criteria for the depth of water and type of target analytes. A description of common pump types can be found in Pump Information Attachment 1.

1. Complete the pre-sampling procedures as outlined in Section 2.0.

2. Determine the appropriate purge water volume as described in Section 3.2.

3. Assemble pump, hoses and safety cable, and lower the pump into the well at the appropriate depth below the water. Only properly decontaminated purging equipment should be introduced into the well. Care should be taken not to drop the pump in the well and over-disturb the water column. The pump should be placed just below the water level, making sure the pump is deep enough so that purging does not evacuate all the water (running the pump without water may cause damage), but keeping it above the screened interval if possible.

4. Attach a flow meter to the outlet hose to measure the volume of water purged. If a flow meter is not available, a bucket of known volume and stopwatch may be used to measure the volume of water purged and pumping rate.

5. The water level should be monitored during purging to ensure air does not enter the pump, and that the pump is set at an appropriate pump rate. If the pumping rate exceeds the well recharge rate, lower the pump further into the well and continue pumping, or if possible, decrease the pumping rate.

6. Purge the well until the specified volume of water has been evacuated. Record the total volume purged in field notebook. If a fuel powered pump is used, it should be located downwind of the sampling collection point.

7. If any purging equipment is being used at more than one well, it should be properly decontaminated prior to sampling the next well.

3.4 WELL-VOLUME METHOD SAMPLING PROCEDURES

3.4.1 Sampling with a Bailer

Generally, bailers can provide an acceptable sample, as long as sampling personnel use extra care in the collection process. Site-specific conditions or target analytes may necessitate the need to use an alternative sampling method. Bailing a well can disturb the water when repeatedly lowered into the well introducing bias, especially when sampling for VOCs and metals (USEPA, 2002).

1. Complete the pre-sampling activities as outlined in Section 2.0.

2. Perform the purging method as outlined in Section 3.3.1. The same bailer and line may be used for sampling.

3. Collect samples immediately after purging is complete, but if necessary, allow the well to recharge so a sample can be collected. If a well is purged dry, the well should be sampled within 24 hours and no sooner than 2 hours. See Section 7.2.

4. Lower the bailer slowly and gently into the well, taking care not to shake the casing sides or to splash the bailer into the water. Stop lowering at a point adjacent below the top of the screen.

5. Allow the bailer to fill and then slowly and gently retrieve the bailer from the well, avoiding contact with the casing, so as not to knock flakes of rust or other foreign materials into the bailer or the well.

6. Remove the cap from the pre-labeled sample container(s). Do not place the cap on the ground. Pour water slowly and gently from the bailer or open the stopcock, being careful not to agitate the sample. Care should be taken not to allow the water from one end of the bailer to rush out of the open end of the bailer while pouring water into sample bottles since this can cause agitation.

7. Filter samples, if required by the field sampling plan.

8. Place cap on the sample container tightly, place sample in plastic bag, and place sample container into a cooler.

9. Log all pertinent sampling information in field notebook (date, sample collection time, location, etc.) and fill out chain-of-custody forms.

10. If any sampling equipment is being used at more than one well, it should be properly decontaminated prior to sampling the next well. The use of bailers dedicated to a single well is recommended.

3.4.2 Sampling with a Pump

Selection of a sampling pump should be based on an evaluation of how the pump will affect the target analyte. Some pumps can cause chemical or physical changes such as aeration or volatilization, which could affect the representativeness of the sample.

1. Complete pre-sampling activities as outlined in Section 2.0.

2. Complete purging method as outlined in Section 3.3.2. Only properly decontaminated sampling equipment should be introduced to the well.

3. Samples should be collected immediately after purging is complete without changing the position of the pump or turning it off (if the same pump is used). It may be necessary to allow the well to recharge so a sample can be collected. If a well is purged dry, the well should be sampled within 24 hours and no sooner than 2 hours. See Section 7.2.

4. Remove the cap from the pre-labeled sample container(s). Do not place the cap on the ground. Fill the appropriate sample bottle(s).

5. Filter samples, if required by the field sampling plan.

6. Place cap on the sample container tightly, place sample container in plastic bag, and place sample container in a cooler.

7. Log all pertinent sampling information in field notebook (date, sample collection time, location, etc.) and fill chain-of-custody forms.

8. Upon completion, remove pump and assembly. All pump equipment should be properly decontaminated prior to sampling the next well.

3.5 PURGING AND SAMPLING DOMESTIC AND LAWN AND GARDEN WELLS

Turn on a household fixture (preferably an outside faucet) and allow the well to discharge for a minimum of 5 to 10 minutes. Remember to document the exact amount of time the well was purged. Make certain the discharge point is on the well-side of any water filtering or conditioning device or screen. Do not sample through garden hoses. Collect the sample directly from the faucet, but do not touch the sample container to the faucet. Minimize aeration of discharge during sampling, if possible. If a home has a pressure tank that is used prior to the faucet to be sampled, then it is important to purge enough water to drain the pressure tank prior to sampling so the sample is collected from the well and not water stored in the pressure tank.

If specified by a site-specific work plan, field parameters (dissolved oxygen, specific conductance, pH, temperature, etc.) can be monitored during the evacuation process. When field parameters are within the stabilization criteria described in Section 4.6 for three consecutive measurements, the well is considered purged and a sample can be collected.

4.0 LOW-FLOW SAMPLING METHOD

4.1 DESCRIPTION OF THE LOW-FLOW METHOD

The term “low-flow” refers to the velocity at which water enters the pump intake from the surrounding formation in the immediate vicinity of the well screen. It is assumed that pumping at a low rate within the screened interval of a well will minimize drawdown and the mixing of stagnant water with formation water, which should result in a representative sample of the formation water. Water quality parameters are monitored during the low-flow purging process until sufficient stabilization of water quality parameters has been reached before collection of a sample. References consulted during development of procedures for low-flow sampling include guidance documents from the U. S. Environmental Protection Agency (USEPA 1996, 2001, 2002) and the ASTM International (ASTM 2002).

The low-flow purging and sampling method is best used for situations where the well has a discrete screened interval (10 feet or less) and the aquifer materials are sufficiently permeable to allow drawdown in the well to stabilize during the purging process. This method of purging and sampling should not be used for wells that are screened in low permeability materials where drawdown cannot achieve stabilization while pumping. In addition, this method of purging and sampling is not intended for wells that contain non-aqueous phase liquids.

Some of the advantages of using the low-flow techniques for purging and sampling can include:

- Improved sample quality by minimizing the disturbance in the well;
- Less mixing of the stagnant casing water with the formation water;
- Samples are more representative of the mobile load of contaminants present in the aquifer reducing the need for filtering the water samples;
- The purging and sampling time is reduced; and
- Purge volumes are smaller resulting in generation of less wastewater.

Some disadvantages for the low-flow method of purging and sampling can include:

- The necessity for more equipment such as variable speed pump with the capability to pump at low rates, a flow-through cell that includes ph, oxidation-reduction potential (ORP), dissolved oxygen (DO), temperature, specific conductance, and a turbidity probe and meter(s);
- Additional cost and time can be incurred since stabilization of water parameters may require relatively longer times;
- Sample results may not be reproducible if the pump is placed at a different depth within the screened interval each time the well is sampled.

4.2 LOW-FLOW SAMPLING EQUIPMENT

NOTE: a majority of this equipment is needed for all types of groundwater sampling.

- well construction information including screened interval, total depth, and well diameter;

STANDARD OPERATING PROCEDURE – BER-02

COLLECTION OF SURFACE WATER SAMPLES AT SUSPECTED OR KNOWN CONTAMINATED SITES

Effective Date: August 14, 2000
Revised Date: January 1, 2011

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DISCLAIMER:

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In general, this document should be used as a reference. Differences may exist between the procedures referenced in this document and what is appropriate under site-specific conditions. This document does not represent an endorsement of practitioners or products mentioned in the document.

1.0 INTRODUCTION

Surface water samples may be required to establish the existence or extent of contaminant migration. Such data helps investigators identify risks to populations and determine appropriate remedial actions. Comparisons of water chemistry from sampling points upstream to sampling points on-site and downstream from the site are used to evaluate contamination releases. This standard operating procedure (SOP) outlines general considerations and procedures applicable to the collection of a representative surface water sample from a majority of surface waters and impoundments in Kansas. Site-specific circumstances can vary widely from site to site and no universal sampling procedure can be recommended or followed. Techniques and methods must be determined on a site-specific basis (USEPA, 1991). Pertinent surface water sampling SOPs should be outlined in the site-specific quality assurance project plan (QAPP) and the locations and analyses should be outlined in the field sampling plan (FSP).

2.0 EQUIPMENT

The equipment needed for surface water sampling during investigations of contaminated sites is minimal. In most instances, the sample container serves as the sampling device. The use of highly sophisticated or automatic sampling devices is normally not required for routine site investigations. If a more rigorous evaluation of surface water is necessary for a specific site, please refer to the *USGS National Field Manual for the Collection of Water-Quality Data* for additional information.

Several types of sampling devices are available for collecting surface water samples such as the Nansen bottle, DO dunker, Kemmerer sampler and Van Dorn sampler. The sampling method selection depends upon the physical site characteristics and the intended analyses. The following is a general list of equipment used for surface water sampling:

1. Buffer Solutions (pH 4, pH 7 and pH 10)

2. Chain-of-Custody Seals

3. Container Brush

4. Conductivity Meter and calibration solutions

5. Sample containers (with screw caps lined with Teflon)

6. Dissolved Oxygen Indicator (w/probe for field use)

7. Distilled Water

8. Electrical Tape

9. Grease Pencils

10. Hip Boots

11. pH Meter, calibration solutions, and pH Hydrion paper - wide range

12. Plastic Beaker (1000 ml)

13. Polyethylene Bags (8" x 12", 10" x 16", and 12" x 20"

14. Pressure Filtering Apparatus

15. 0.45 micron filters

16. Safety goggles

17. Sample Collection Device (Nansen bottle, DO dunker, Dip Sampler, Discrete Sampler (Kemmerer Sampler and/or Van Dorn Samplers)

18. Tape Measure

19. Global Positioning System Unit (GPS)

3.0 SAMPLING APPROACH

3.1 SELECTION OF SAMPLING LOCATIONS FOR FIELD SAMPLING PLANS

Surface water sampling locations are selected on the basis of their probability for demonstrating contaminant migration. Prior to sampling, surface water drainage in and around a site should be characterized using all available background information, including topographic maps and river basin studies. Air photos may be used to develop drainage maps which can then be confirmed by an initial survey of the surface water adjacent to or on a site. An initial survey of potential sampling points is essential to the development of a work plan. Furthermore, it is possible to anticipate any special equipment or personnel safety requirements which might be necessitated by terrain or other factors. It may also be appropriate to evaluate the temporal presence of surface water under differing seasonal or weather conditions. This initial survey allows field personnel to identify landmarks which locate sampling points, a crucial step in maintaining documentation of activities for legal actions.

In general, sampling locations may include rivers, creeks, or streams running through or adjacent to a site, including those bodies of water which may receive surface runoff or leachate from a site. Surface water samples may also be collected from lakes, stock watering ponds, or other types of impoundments.

The number of sampling locations is dependent on a variety of factors, including the size of a site and the availability of analytical support. An absolute minimum number would be two locations, one background and one down-stream sample, but three sampling locations are recommended including one background, one at or next to the potential impact area, and one down-stream. Additional locations could be sampled to show concentration changes down-gradient from the source and to provide data to document the extent of impact downstream.

It is essential to establish the quality of water prior to its contact with the site. Surface drainage patterns should be carefully studied to determine background sampling locations. Samples should be collected from each surface water source that is entering the stream between the background and downstream sampling point to identify potential impacts from other drainages. A sample should be collected from each upstream surface water source entering the site just prior to the confluence with the primary stream. For standing bodies of water, a background sample may be collected from a similar water body away from the suspected area of contaminant release.

Ease of access to the sampling location may be an important consideration when the samplers must carry a large amount of equipment to the site. Bridges can sometimes provide good vantage points for sampling when composite samples are being collected. However, the need to sample point sources, such as stream flow from waste dumps, leachate breakouts, or drainage from mined areas may override site selection based on accessibility. Wading for water samples is not recommended in shallow lakes, ponds, and slow-moving rivers and streams because bottom deposits are easily disturbed resulting in increased sediment in the overlying water column. However, wading may be the only practical means for sample collection. Wading procedures should be determined on a site-by-site basis. In slow moving, deep water, a boat is usually required for sampling.

3.2 RIVERS, STREAM, AND CREEKS

In the selection of surface water sampling sites on rivers, streams, and creeks, areas that exhibit the greatest degree of cross-sectional homogeneity should be located. When available, previously collected data may indicate whether potential sampling locations are well mixed or vertically or horizontally stratified. Since mixing is principally governed by turbulence and water velocity, the selection of a site immediately below riffle areas provides good vertical mixing. Horizontal (cross-channel) mixing occurs in constrictions in the channel. When several stations along a stream are to be sampled, they should be strategically located. Selection of sampling sites is often based upon accessibility, stream velocity, location of confluences, intake points for water supplies, and stream geomorphology. It may be necessary to assess the individual contribution of stream or river segments when evaluating a site with multiple drainage pathways.

Actual sample locations will vary with the size of the water body and the amount of turbulence in the stream or river. Generally, with small streams less than about 20 feet wide, a sampling site can be found where the water is well-mixed. In such cases, a single grab sample collected at mid-depth in the center of the channel is adequate to represent the entire cross-section. (A sediment sample can also be collected in the center of the channel, however; the sediment samples should be collected after the surface water sample is obtained). For slightly larger streams, at least one vertical composite should be collected from mid-stream just below the surface, at mid-depth, and just above the bottom. Measurements of pH, temperature and specific conductivity are made and recorded on each aliquot of the vertical composite. Dissolved oxygen is an optional parameter that can be used to determine if a body of water is stratified. Several vertical composites should be collected in rivers. These vertical composites should be located in a manner that is roughly proportional to flow, i.e., they should be closer together toward mid-channel, where most of the flow travels, as opposed to toward the banks, where the proportion of total flow is smaller. The number of vertical composites required and the number of depths sampled for each are determined by the site Field Sampling Plan (FSP). The sample locations and numbers specified in the FSP should be based on a reasonable balance between two considerations:

> The larger the number of subsamples, the more likely the composite sample will represent the water body; however, collecting numerous subsamples is time-consuming and expensive, and can increase the chance of contamination.

If a site is relatively large or complex with respect to surface water, it may be appropriate to design a surface water sampling plan that can be evaluated on a statistical basis.

3.3 LAKES, PONDS, AND IMPOUNDMENTS

Sampling locations may include any adjacent standing bodies of water such as lakes, stock watering ponds, sediment or flood control ponds, marshes, or ox-bow lakes which could receive contaminants. The number of water sampling sites on a lake, pond, or impoundment will vary with the depth, size and shape of the basin. Procedures for collecting samples from impoundments on hazardous waste sites should be evaluated if high concentrations of contaminants are present.

Standing surface waters have a much greater tendency to stratify than rivers and streams. The relative lack of mixing requires that more subsamples be collected. In ponds and small impoundments, a single vertical composite at the deepest point may be sufficient. In naturally formed ponds, the deepest point is usually near the center; in impoundments, the deepest point is usually near the dam. It may be necessary to collect parameters, such as dissolved oxygen, to determine the degree of stratification.

In lakes and larger impoundments, several vertical aliquots may be composited to form a single sample. These aliquots are often taken along a transect or grid. The number of vertical composites and the depths at which samples are collected are outlined in the FSP. If samples will be analyzed for volatile organic compounds (VOCs), only grab samples should be collected for this parameter due to the potential for loss of volatiles while compositing.

Lakes with irregular shapes and with several bays and coves that are protected from the wind may require additional separate composite samples to represent water quality adequately. Similarly, additional samples should be taken where discharges, tributaries, land use characteristics, and other such factors are suspected of influencing water quality.

3.4 LEACHATES

Leachates can be formed by the mixing of rain water with wastes. A leachate may enter groundwater and/or surface water systems causing deterioration of the water quality. In areas where the ground surface slopes steeply away from the buried wastes, the leachate may "break out" or emerge on the ground surface. This situation is typically encountered at landfills or at the foot of mine tailings disposal piles. Samples taken from leachate streams may have to be treated as medium or high concentration samples depending upon the field evaluation.

4.0 GENERAL SAMPLING TECHNIQUES

Most surface water samples collected during site investigations are grab samples. Typically, surface water sampling involves immersing the sample container in the body of water; however, the following general suggestions will help ensure that the samples collected are representative of site conditions:

1. The most representative stream samples are collected from mid-channel at 0.6 stream depth in a well-mixed stream;

2. Stagnated areas or pools in a stream or river might contain zones of varying pollutant concentrations, depending upon the physical/chemical properties of the contaminants and the proximity of these stagnated areas to the site;

3. When sampling running water, it is suggested that sampling progress from downstream to upstream to eliminate sediment disturbance in subsequent samples.

4. To sample a pond or other standing body of water, the surface area may be divided into grids. A series of samples taken from each grid is combined into one sample, or several grids may be selected at random;

5. If sample bottles contain preservative or if the sample is collected for VOC analysis, a different clean container should be used to collect the sample and decant the sample into the preserved bottles. If required by site-specific FSP, filtering of samples should be conducted immediately after sample collection.

6. Care should be taken to avoid excessive agitation of the water during transfer from source to bottle. Agitation could result in the loss of volatile constituents;

7. It should be noted that only grab samples should be collected for analysis of VOCs due to the potential for loss of volatiles while compositing. When collecting samples in 40 ml septum vials for VOC analysis, exclude any air space from the top of the bottle and to be sure that the Teflon liner faces in after the bottle is filled and capped. The container should be slowly filled to overflowing, creating a convex meniscus at the

STANDARD OPERATING PROCEDURE – BER-03

COLLECTION OF SOIL SAMPLES FOR LABORATORY ANALYSIS

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1.0 INTRODUCTION

The objective of this Standard Operating Procedure (SOP) is to establish guidelines for the collection of soil samples for fixed laboratory analysis. Please note that this SOP is not applicable for collection of soil samples for field screening purposes (e.g., immunoassay or colorimetric test kits screening, among others) that may have special container and sample processing requirements (refer to KDHE SOP BER-31, *Field-based Colorimetric Analysis*). This SOP is applicable for collection of soil samples from hand auger samplers, slide-hammer samplers, grab samples from stockpiled or land farmed soils, surface samples, and test pit or excavation confirmation samples, among others. To collect soil samples from split-spoon samplers during drilling, please refer to SOP BER-06, *Installation of Monitoring Wells*. To collect soil samples using direct-push technology (DPT) such as a Geoprobe®, please refer to KDHE SOP BER-07, *KDHE Geoprobe Operations*. Additionally, sampling protocol techniques for U.S. Environmental Protection Agency (EPA) Method 5035, *Closed-System Purge-and-Trap and. Extraction for Volatile Organics in Soil and Water Samples*, are not included in this SOP. Collection of soil samples by Method 5035 should follow the appropriate manufacturer or laboratory-specific protocol.

2.0 METHOD SUMMARY

Soil samples may be collected in either a random or biased manner. Random samples can be based on a grid system or statistical methodology. Biased samples can be collected in areas of visible impact, from locations required to meet regulatory compliance or in suspected source areas, among other locations. Soil samples can be collected at the surface, shallow subsurface, or at depth. Commonly, surface sampling refers to the collection of samples at a depth interval of 0 to 12 inches. When samples are collected at depth, the water content should be noted, since generally "soil sampling" is restricted to the unsaturated zone. Certain regulatory agencies may define the depth interval of a surface sample differently, and this must be defined in the work plan/sampling plan. A detailed description of the sampling locations and proposed methods of sample collection should be included in the work plan/sampling plan.

Similar to sediment sample collection, collection of surface soil samples is most efficiently accomplished with the use of a stainless steel trowel or scoop. However, equipment selection will ultimately be determined by the depth of the sample to be collected, surrounding terrain, and accessibility. For samples at greater depths, a bucket auger, power auger, or slide-hammer may be needed to advance the hole to the point of desired sample collection. To collect samples at depths greater than practical with hand equipment, the use of a drill rig with a split spoon sampler or a DPT rig equipped with a soil coring device may be necessary. In some situations, such as confirmation sampling of excavation sidewalls or floors, sample locations may be accessed with the use of a backhoe.

3.0 MATERIALS/EQUIPMENT

The following materials and equipment may be required. Please note that this is not an exhaustive list of all materials and equipment potentially necessary for all soil sampling events, but is intended as a guideline for items commonly used. Site-specific sampling requirements may dictate the use of additional items not included in the following list. Ensure that ample time is allowed for obtaining necessary sampling apparatus from the analytical laboratory in advance of mobilizing to the field.

a. An approved work plan/sampling plan which outlines soil sampling requirements.

b. Field notebook, field form(s), Kansas One Call tickets/utility clearance checklist, site maps, chain-of-custody forms, and custody seals.

c. Decontamination supplies (including: non-phosphate, laboratory grade detergent, buckets, nylon scrub brushes, potable water, de-ionized or distilled water, regulatory-required reagents, etc.)

d. Stakes or flags

e. Sampling device (e.g., stainless steel hand auger, slide-hammer soil sampler, stainless steel trowel, etc.). Note: Do not use sampling devices plated with chrome or coatings.

f. Disposable sampling gloves (nitrile, latex, among others).

g. Laboratory-supplied sample containers with labels. If needed, sample liners/sleeves for slide hammer or split-spoon sampler (e.g., brass, stainless steel, acetate), polytetrafluoroethylene (PTFE; Teflon®) tape, and plastic caps.

h. Cooler(s) with double-bagged water ice.

i. Plastic sheeting (minimum 6-mil thickness).

j. Black pen and indelible marker.

k. Zip-lock bags and packing material (e.g., bubble wrap or bubble wrap bags or similar cushioning materials).

l. Tape measure.

m. Paper towels.

n. Clear packing tape.

o. Overnight (express) shipment forms (if needed).

p. Trash bags

q. Global Positioning System (GPS) device

r. Digital Camera

s. Photoionization detector (PID), flame ionization detector (FID), or similar organic vapor measuring instrument.

t. Combustible gas indicator (CGI), if necessary

4.0 DECONTAMINATION

All reusable sampling equipment must be thoroughly cleaned and decontaminated before and after each use according to KDHE SOP, BER-05, *Decontamination of Equipment*. Disposable items such as sampling gloves and plastic sheeting will be changed after each use and discarded in an appropriate manner as general trash.

5.0 PROCEDURE

a. Prior to field sampling activities, determine if utility clearance will be required and, if necessary, perform utility clearance and operation of equipment in accordance with the State of Kansas Underground Utility Damage Prevention Act (Kansas Statutes Annotated [K.S.A.] 66-1801 to 66-1816). Ensure that all access agreements (as required) have been signed and executed prior to mobilizing to the sampling location(s).

b. Use flags or other markers to identify sample locations. If needed, adjust proposed sampling locations based on site access, property boundaries, and surface, subsurface, or overhead utilities or other obstructions.

c. Prior to collecting soil samples, ensure that all sampling equipment has been thoroughly cleaned and decontaminated according to KDHE SOP BER-05 referenced above, and that all equipment is free of mechanical defects and is in working order. Be aware of sampling locations where collection of quality assurance/quality control (QA/QC) samples may require additional soil volume to be collected to fulfill QA/QC sampling requirements.

d. Wearing disposable sampling gloves and using a clean, decontaminated sampling device (e.g., stainless steel hand auger, slide-hammer soil sampler, stainless steel trowel, or shovel, among others), clear surface debris (e.g., rocks, vegetation, trash or other obstructions) from the sample location to expose a fresh soil surface for soil sample collection. For collection of deeper soil samples, a shovel, auger, or mechanical excavator may be used or required to excavate or retrieve soil from the desired sampling depth.

e. Using disposable gloves and a pre-cleaned, stainless steel spatula, scoop, or spoon for each sample, extract the soil sample from the sampler or collect the sample from the surface, stockpiles, or landfarms. Disposable plastic spoons may also be used.

f. Sample parameters should be collected in the following order, based on volatility:

g. Volatile organic compounds (VOCs)

h. Semi-volatile organic compounds (SVOCs), including pesticides, herbicides, total petroleum hydrocarbons – gasoline range organics (TPH-GRO), TPH-diesel range organics (TPH-DRO), and polychlorinated biphenyls (PCBs).

i. Metals.

j. Place the sample in a laboratory-supplied, pre-cleaned sample container. Soil collected for VOC (EPA SW-846 Method 8260B) analysis should be transferred to sample containers with PTFE-lined lids as quickly as possible to avoid loss of volatile contaminants. When using sample sleeves or liners, PTFE film should be placed between the sample and the end caps. If elevated contamination is suspected in any of the samples collected, it is suggested that these samples be placed in a separate cooler than background or other less contaminated soils to reduce the possibility of cross-contamination.

k. Project-specific requirements may dictate that VOC samples be collected for analysis by EPA SW-846 Method 5035. Collection of samples for EPA SW-846 Method 5035 involves the use of specific sampling apparatus (e.g., TerraCore®, EnCore®) in addition to specific containers and preservatives. Follow the manufacturers' and/or laboratory instructions for sample collection and handling for EPA SW_846 Method 5035. Ensure that sufficient volume of soil for dry weight analysis is included with the aliquot for EPA SW-846 Method 5035 analysis.

l. Label the sample container with appropriate information such as client name, site location, sample identification, date and time of collection, sampler's initials, preservative (if any), and analyses requested. Additional project-specific identifiers and/or labeling may also be required.

STANDARD OPERATING PROCEDURE – BER-04

COLLECTION OF SEDIMENT SAMPLES

Effective Date: February 15, 2000
Revised Date: January 1, 2011

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DISCLAIMER:

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KDHE has made every attempt to present the information in a clear and concise manner for a variety of users. However, KDHE is not responsible for the misuse or misinterpretation of the information presented herein. Under no circumstances shall KDHE be liable for any actions taken or omissions made by non-KDHE users of this document.

In general, this document should be used as a reference. Differences may exist between the procedures referenced in this document and what is appropriate under site-specific conditions. This document does not represent an endorsement of practitioners or products mentioned in the document.

1.0 INTRODUCTION

The objective of this Standard Operating Procedure (SOP) is to establish guidelines for the collection of sediment samples for laboratory analysis. Sediments are defined as those mineral and organic materials situated beneath an aqueous layer. The aqueous layer may be either static, as in lakes, ponds, or other impoundments or flowing, as in rivers and streams (EPA, 1999). Background information can provide an indication of the types of substances which may be present in sediments.

Sediment samples are valuable for locating pollutants of low water solubility and high soil binding affinity. Where surface water might show trace quantities of contaminants, thus leading investigators to believe that off-site contaminant migration is minor, the analysis of sediments might show otherwise. Heavy metals and high molecular weight hydrocarbons are examples of contaminants which might be found in greater concentrations in sediments than in the overlying water column.

Substrate particle size and organic content are directly related to water velocity and flow characteristics of a body of water. Contaminants are more likely to be concentrated in sediments typified by fine particle size and a high organic content. This type of sediment is most likely to be collected from depositional zones. In contrast, coarse sediments with low organic content do not typically concentrate pollutants and are found in erosional zones. The selection of a sampling location can, therefore, greatly influence the analytical results (EPA, 1999).

It is important to note that the sediments obtained from surface impoundments, such as lagoons, which are suspected to be highly concentrated, are to be handled and treated as hazardous materials samples. This SOP addresses collecting those sediment samples that can be treated and handled as environmental samples. Please refer to KDHE SOP BER-19, Guidelines for Sampling Hazardous Materials, for procedures to be followed for hazardous materials sample collection.

2.0 METHOD SUMMARY

Fresh water environments are commonly separated into three groups: flowing waters, such as rivers, streams, and creeks; static water bodies, such as lakes, ponds, and impoundments; and estuaries. Sample equipment and collection must be adapted to the waterway as each has differing characteristics. Selection of a sampling device is most often contingent upon: 1) the depth of water at the sampling location, and 2) the physical characteristics of the medium to be sampled.

Sediment is collected from beneath an aqueous layer either directly, using a hand held device such as a shovel, trowel, coring device or auger; or indirectly, using a remotely activated device such as an Ekman or Ponar dredge. It is noted that dredge-type samplers are typically not used for collecting surface sediment samples (used mostly for collection of samples for biological analyses). Dredge samplers provide inadequate control of sample location, volume, and depth (USGS 1997), cause disruption of sediment and pore water integrity (EPA 2001), as well as a loss of fine-grained sediments (EPA 2001). Because of these reasons, grab and core samplers are recommended for collecting surface sediments.

Most samples will be grab samples, although sometimes sediment taken from multiple locations may be combined (composited) into one sample, depending on project or task-specific requirements. Following collection, sediment is transferred from the sampling device to a sample container of appropriate size and construction for the analyses requested. Composited samples are not acceptable for volatile organic compound (VOC) analysis.

2.1 SAMPLING CONSIDERATIONS

The following items should be considered when sampling.

a. Many pollutants adsorb onto sediments having a large surface-to-volume ratio. Therefore, silts and clays will contain higher concentrations of organic compounds and trace metals than coarser sediments such as sands and gravels. Sampling sediments with a larger surface-to-volume ratio is preferable.

b. Hydrologic information should be recorded which can help establish a relationship between the contaminant source and the contaminants in sediments. This information should include stream characteristics (width, depth, stream flow, etc) and the interrelationship of surface water with groundwater (i.e., gaining verses losing stream).

c. Samples for organic analyses should not be collected from areas exposed to the air during periods of low flow or low recharge.

d. The pH of the surface water over the sediments should be determined to identify any unusual pH conditions which may influence contaminant mobility and retention by the sediments.

e. Sediment samples should be obtained from the area nearest the suspected contaminant point source, or as required by the approved work plan/sampling plan.

f. Background sample(s) should be obtained from sediments upstream from the suspected point source for flowing water, and from sediments away from the suspected point source for standing surface water. In circumstances where elevated contamination of small bodies of standing water is present, a similar body of water away from the suspected source area of contamination could be used for background samples. However, it may be impossible to find a representative background sample location for small standing water bodies with high contaminant levels. The analysis of background sediments is required to establish the contribution of the source to contaminant levels in the area.

g. Chemical preservation of solids (i.e., sediment samples) is generally not recommended. Cooling to between 2°C and 6°C is usually the best approach, supplemented by meeting the appropriate and required holding time(s).

h. Use procedures that minimize disturbance and sample washing. Collect downstream samples first and proceed upstream. The collection and manipulation of sediments can change their chemical and physical characteristics.

i. When sampling surface waters and sediments, always collect water samples before sediment samples to avoid disturbing sediments into the water column and biasing the water sample.

j. When sampling sediment from bodies of water containing known or suspected hazardous substances, adequate precautions must be taken to ensure the sampler's safety. The team member collecting the sample should not get too close to the edge of the water, where bank failure may cause him or her to lose balance. To prevent this, the person performing the sampling should be on a lifeline, and be wearing adequate protective equipment. If sampling from a vessel is necessary, ensure that all required boating permits are obtained and/or possessed in advance of sampling activities. Implement appropriate protective measures as required by the health and safety plan or facility where the sampling is being conducted.

k. Stainless steel or plastic scoops, spoons, or coring devices should be used when possible. Devices plated with chrome or other materials should be avoided.

3.0 MATERIALS AND EQUIPMENT

The following list of materials and equipment is intended to serve as a guide for sediment sampling. Please be aware that additional materials and equipment may be necessary due to site-specific conditions or requirements.

a. Sampling plan or work plan, field notebook, site map(s), Chain-of-Custody forms, field data sheets, pens/markers, etc.

b. Digital camera

c. Global Positioning System (GPS) unit

d. Calibrated Dissolved Oxygen/temperature/conductivity/pH/flow meters

e. Measuring tape

f. Survey flags/stakes, and/or buoys with anchors as required

g. Rope or twine (nylon)

h. Ziplock bags

i. Safety equipment

j. Rubber boots, chest waders, plastic apron, etc.

k. Plastic sheets/tarps/trash bags

l. Tool box with basic tools (e.g., Pliers, hammer, screwdrivers, end wrenches, socket wrench and sockets, among others)

m. Pocket knife with locking blade

n. Stainless-steel trowel, spoons, spatula, Teflon beaker, shovel

o. Sediment coring device, bucket auger with butterfly valve (extensions and handles), split spoon sampler, dredge, etc.

p. Compositing container/bowl, aluminum pie pans, aluminum foil

q. Disposable sampling gloves (e.g., nitrile, latex)

r. Sample containers (4-ounce or 8-ounce wide mouth glass containers with Teflon lined caps) or other appropriate sample container(s)

s. Sample labels

t. Double-bagged ice and coolers

u. Decontamination supplies and equipment (5-gallon buckets, nylon scrub brushes, non-phosphate, laboratory-grade detergent [e.g., Alconox, Liquinox], potable water, deionized or distilled water, paper towels)

4.0 SAMPLING PROCEDURES

Very simple techniques can usually be employed for sediment sampling. Selection of a sampling device is most often contingent upon: 1) the depth of water at the sampling location; 2) the physical characteristics of the medium to be sampled; 3) the portion of the sediment profile to be sampled (surface or subsurface); and, 4) type of sample to be collected (disturbed or undisturbed). As previously discussed, most sediment samples will be grab samples, although sometimes sediment taken from multiple locations may be combined (composited) into one sample, depending on project or task-specific requirements. If possible, attempt to limit the amount of surface water contained in the sediment sample. Remove excess surface water from the sample container by siphoning (not decanting), taking care to retain the fine sediment fraction.

4.1 SAMPLING

It is important to follow the operating procedures specific to each sampling device. Factors to consider for selection of the appropriate sampling device include particle size (soft versus compacted), sample depth, water depth, and waterway characteristics, among others.

Grab samples are recommended for surficial sediment collection when accurate resolution of sediment depths is not necessary. Core samples are recommended if the depth of contamination is to be characterized.

If field-based analysis or field screening is being conducted on the sediment samples, follow the appropriate KDHE SOP: KDHE SOP BER-27, *Collection of Solid Samples for XRF Analysis*; KDHE SOP BER-13, *Headspace Method for Screening Soil Samples for Volatile Organic Vapors;* and, KDHE SOP BER-31, *Field-Based Colorimetric Analysis*.

Suggested sediment sampling procedures include the following:

a. Use stakes, flagging, or buoys to identify and mark all sampling locations. The proposed locations may be adjusted from the work plan based on site access, property boundaries, and surface, subsurface, or overhead obstructions.

STANDARD OPERATING PROCEDURE – BER-05

DECONTAMINATION OF EQUIPMENT

Effective Date: August 14, 2000
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1.0 INTRODUCTION

The objective of this Standard Operating Procedure (SOP) is to establish a consistent process for decontamination of sampling equipment to prevent cross-contamination between sampling locations and events. Preventing cross-contamination in samples is important for reducing the introduction of error into sampling results and for protecting the health and safety of site personnel.

2.0 METHOD SUMMARY

The contamination of equipment requires physical removal by methods such as brushes and high pressure water. This is followed by washing and rinsing the equipment.

3.0 PROCEDURE

1. When applicable, visible contamination should be removed with a metal or nylon brush and/or high pressure water spray.

2. Wash equipment with a non-phosphate detergent solution such as Alconox or an equivalent.

3. Rinse with tap water.

4. Final rinse with deionized/distilled water.

4.0 GENERAL CONSIDERATIONS

1. The use of distilled or deionozed water commonly available from commercial vendors is acceptable for decontamination of sampling equipment. Field blanks may be used to verify the quality of commercially available water.

2. Several procedures can be established to minimize contact with waste and the potential for contamination. For example:

   - Stress work practices that minimize contact with hazardous substances.

   - Use appropriate personal protective equipment (PPE) (e.g. gloves) when handling contaminated equipment; **do not** use contaminated PPE to handle clean equipment.

- Use disposable sampling equipment when appropriate.

3. As part of project planning documentation, develop a decontamination plan before any personnel or equipment enter areas of potential exposure. The equipment decontamination plan may include:

   - The number, location and layout of decontamination stations;
   - Which decontamination apparatuses are required;
   - Methods for disposal of contaminated clothing, disposable equipment and water (can decontamination water be discharged to the ground surface or sanitary sewer, does it need to be treated prior to on-site disposal or disposed off-site).

5.0 SPECIAL CONSIDERATIONS

Sample containers used by KDHE/BER personnel will be decontaminated by the laboratory or vendor from which the containers are obtained.

6.0 GEOPROBE AND DRILL RIG DECONTAMINATION

Specific decontamination procedures are necessary for KDHE's Geoprobe and drill rigs because of the very high frequency of use in KDHE field activities. In general, the following norms apply unless modified by a site-specific work plan. All rods and sampling devices should be visually inspected before use. If visually contaminated, these should not be used. All rods, augers and sampling devices that have been advanced within a contaminated or potentially contaminated site should be decontaminated after use. Decontamination can be done on-site or off-site and should comply with the general instructions above.

Due to the large area required to stage and decontaminate equipment, commercial car washes are frequently utilized for decontamination of Geoprobe rods, drill rig augers and associated sampling devices. Decontamination should be done in a manner compliant with State and local wastewater treatment regulations. The wash facility should be visually inspected before and during decontamination to assure dirt, contaminants, etc. from the facility are not introduced inadvertently during the decontamination process. NOTE: It is important that visible contamination be removed from the probe rods and augers at the site prior decontamination at a car wash. The visible material removed should be treated as Investigative Derived Waste (IDW) in accordance with BER-SOP-08.

If a site is being sampled for constituents frequently occurring in chlorinated water supplies (trichloromethane, trihalomethane compounds, etc.) a rinse blank sample for volatile organic compounds (VOCs) should be obtained at least once during the decontamination process per site as chlorinated water sources often contain these

constituents, and cross-contamination is a possibility. For sites with other types of contaminants, the site-specific work plan should detail the frequency and type of quality control samples for the decontamination process for Geoprobe and drilling operations.

7.0 REFERENCES

1. United States Environmental Protection Agency (U.S. EPA). Region 4, *Field Equipment Cleaning and Decontamination Operating Procedure.* Document #SESDPROC-205-R1, November 2007.

2. United States Environmental Protection Agency (U.S. EPA) *Sampling Equipment Decontamination,* SOP #2006, August 1994.

STANDARD OPERATING PROCEDURE – BER-11

EVALUATION AND VALIDATION OF DATA

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1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to establish the criteria that are followed for documenting and tracking the quality of environmental data generated from field sampling activities. Because valid media-quality data are integral to environmental investigations that characterize site conditions, the quality of the data generated by a field investigation is extremely important to the successful completion of a project. The level of data evaluation and validation required is determined by the project data quality objectives and must be outlined in the site specific or generic Quality Assurance Project Plan (QAPP).

1.2 SCOPE

The environmental investigation process is a three phase cycle that includes: (1) Planning Phase, (2) Implementation Phase, and (3) Assessment Phase. This SOP, which is in the Assessment Phase, is used to evaluate and validate data that was generated during the Implementation Phase. The data is validated based on criteria that are established in the Planning Phase. Data verification is the process for evaluating the completeness, correctness, and conformance / compliance of a specific data set against the method, procedural, or contractual specifications. Data validation is used to determine the quality of a specific data set relative to the end use. It focuses on the project's specifications or needs, designed to meet the needs of the decision makers/data users and should note potentially unacceptable departures from the QA Project Plan.

2.0 DATA EVALUATION AND VALIDATION

The degree of data validation depends on the quality of data needed to meet the data quality objectives for the project, which are specified in the QAPP. Data collected to establish qualitative trends, for example, do not require the same level of validation as data generated to support litigation. Standard data quality attributes that are recognized as important are the Data Quality Indicators. Acceptance criteria placed on the data quality indicators of a given data set are sometimes referred to as measurement quality objectives (MQOs). The Data Quality Indicators (DQIs) are defined in Table 3, EPA Guidance for Quality Assurance Project Plans, EPA QA/G-5. MQOs are usually based on the individual DQIs for each matrix and analyte group or analyte.

2.1 PRECISION

Precision is the degree to which the measurement is reproducible and is to be determined by comparison of laboratory designated duplicates or designated laboratory matrix spike/matrix spike duplicates. Precision will be calculated as the relative percent difference (RPD) of the two measurements. The equation is as follows:

RPD = 100% X [Result 1 - Result 2] / [(Result 1 + Result 2) / 2]

2.2 ACCURACY

Accuracy is the degree of agreement between a measured value and a true or known value. Accuracy is evaluated using matrix spike (MS) recoveries, system monitoring compound spike (surrogate) recoveries, or continuing calibration verification (CCV) recoveries. MS samples are samples into which known concentrations of the target compounds of interest have been added (or "spiked"). Surrogate compounds are compounds that behave in a similar manner as the target compounds but are not target compounds and are added (or "spiked") into each sample prior to extraction and analysis. The samples are analyzed by the appropriate analytical method. The result obtained is compared to the known concentration added and the MS or surrogate percent recovery (%R) is calculated. CCV samples are check standards analyzed at intervals not to exceed 12 hours for organic analyses and every 10 samples for inorganic analyses. When matrix spike samples or surrogate compounds are not possible, CCV sample results are used to determine accuracy. Percent recovery is calculated as follows:

MS %R = 100% X [Spiked Result Conc.- Sample Result Conc.] / Spike Conc.
CCV and surrogate %R = 100% X [Result Conc.) Known/Spiked Conc.]

2.3 METHOD REPORTING LIMITS

Reporting limits will be based upon method quantitation limits. The procedure for determining the method detection limit for a substance is in Appendix B of Part 136 of Title 40 of the Code of Federal Regulations (40 CFR 136 Appendix B). The method quantitation limit is defined as equivalent to the lowest calibration standard analyzed for each analyte or as ten times the method detection limit.

2.4 COMPLETENESS

Completeness is a measure of the amount of valid, usable data obtained from an analytical data set compared to the amount that was planned to be obtained. Completeness takes into account any breakage, laboratory errors, or sampling difficulties.

Completeness = (# of Valid Data Obtained) / (# of Total Planned Data) x 100

2.5 COMPARABILITY

Comparability expresses the confidence with which one data set can be compared to another. Samples from the same media (i.e., soil, water, etc.) will be considered comparable if the procedures for collecting the samples are complied with and consistent, if the units of measurement are the same, and if the reporting limits are comparable. In addition to obtaining samples in accordance with approved procedures and in a consistent manner, comparability is assured through the use of laboratories using established and approved analytical methods and protocols. The laboratory's quality control program is designed to establish consistency in the performance of the analytical process. The program includes traceability of measurements to standardized reference materials to establish comparability with other laboratory results, and internal controls to verify consistency of a given laboratory's performance. Standard reporting units (e.g., mg/kg, µg/L) will be used for reporting the various parameter results. All data will be subjected to strict QA/QC procedures and reported in a consistent manner to allow for comparison across data sets.

2.6 REPRESENTATIVENESS

The representativeness of the data is the degree to which data represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a function of sample collection and analysis techniques. Data are considered representative if the sampling is performed in accordance with the sampling programs defined in the Field Sampling Plan (FSP) and the analyses meet the requirements outlined in this section and the section on quality control procedures.

3.0 PROCEDURE FOR DATA VALIDATION

The person designated to validate the data for a project will review the data using the criteria established in the QAPP. The degree of validation of the data depends entirely on the quality of data specified in the QAPP. As a minimum, valid data should be supported with evidence that: (1) all field, laboratory, and other procedures used to collect the data are documented so the work can be reproduced by others skilled in the field; (2) all methods and equipment were working properly when the data was collected; and (3) the methods were capable of producing the values reported and that the precision and accuracy or bias of the data are acceptable for the intended use of the data.

To validate the data for a project, the designated person will:

1. Evaluate the quality assurance objectives using the criteria stated in the QAPP. Both field procedures and laboratory procedures will be evaluated.

2. Evaluate field procedures by examining sample collection procedures and sample handling procedures to determine if the QAPP was followed. To evaluate sample handling procedures, methods of sample collection, chain of custody forms, sample preservation, and handling of the samples until received by the laboratory, will be examined.

3. For laboratory procedures on inorganic compounds, the following may be examined during the validation process:

    - Holding times
    - Instrument calibration, including initial and continuing calibration verification
    - Blank(s)
    - Laboratory control sample(s)
    - Inductively Coupled Plasma (ICP) interference check samples
    - Duplicate sample(s)
    - Matrix spike sample(s)
    - Furnace atomic absorption QC
    - ICP serial dilution(s)
    - Sample result verifications
    - Field duplicates

- General data assessment

4. For laboratory procedures on organic compounds, the following may be examined during the validation process:

    - Holding times
    - Gas Chromatograph/Mass Spectrometer (GC/MS) tuning
    - GC calibration, initial and continuing
    - Blanks
    - Surrogate recoveries
    - Matrix spike/matrix spike duplicates
    - Internal standards performances
    - Target Compounds List (TCL) compound identifications
    - Reported detection limits
    - Tentatively identified compounds (TICs)
    - Overall system performance
    - General data assessment

5. The parameters which do not conform to requirements are listed and the data are qualified according to the guidelines listed in the QAPP. The qualified data package is then reviewed and the project data reviewer, the project geochemist and/or the project manager makes a professional judgment concerning the validity of the data package, and its usability for the project.

6. This SOP only includes general guidelines. Additional data quality evaluation/ validation criteria may be established in a QAPP.

4.0 REFERENCES

1. EPA Guidance for Quality Assurance Project Plans, EPA QA/G-5, (December 2002).

2. EPA Guidance on Data Quality Indicators (EPA/QA G-5i) (EPA, 2002b).

3. EPA Guidance for QA Project Plans (EPA/QA/R-5) (May 2001).

4. EPA Guidance on Environmental Data Verification and Data Validation (EPA QA/G-8) (EPA/240/R-02/004).

5. EPA Data Quality Assessment: A Reviewer's Guide (EPA QA/G-9R) (EPA/240/B-06/002).

STANDARD OPERATING PROCEDURE – BER-12

COLLECTION OF QUALITY CONTROL SAMPLES

Effective Date: August 31, 2000
Revised Date: January 1, 2011

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1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to explain the quality control (QC) measures taken to ensure the integrity of the samples collected and to establish the guidelines for the collection of QC samples. The objective of the QC program is to ensure that water-quality data of known and reliable quality are developed.

Documentation of representative data is essential to site investigations; therefore, the data must be validated though the performance of QC sampling. Verification performance sampling is necessary to evaluate and identify contradictory or suspect data. The QC sampling requirements must be determined by the project manager. Data validation measures must be specified as part of all environmental investigations.

The laboratory is responsible for the development and implementation of a laboratory QA/QC program. The collection of field QC samples serves primarily as a check to ensure proper field procedures, but can also serve as a mechanism for the laboratory to perform their QA/QC program (such as collecting sufficient sample for the laboratory to perform matrix spike/matrix spike duplicate samples).

2.0 QUALITY CONTROL SAMPLES

Samples collected for laboratory analysis require the use of quality control samples to monitor sampling activities and laboratory performance. Types of quality control samples may include duplicate and/or duplicate split, trip blank, field equipment blank, matrix spike and matrix spike duplicate, and field matrix spike. A discussion pertaining to each quality control sample follows:

2.1 DUPLICATE AND DUPLICATE SPLIT:

Duplicate sample analysis is performed to evaluate the reproducibility of collection procedures. A duplicate sample is called a split sample when it is collected with or turned over to a second party (e.g., consulting firm) for an independent analysis or submitted to two laboratories for the same analysis. Duplicate samples are two physical samples collected simultaneously from the same location under identical conditions. Duplicate samples may be collected for any media and should be collected in accordance with the sample collection procedures identified in each media specific SOP.

In some cases (not volatile organic compounds), water may have to be accumulated in a common container and then decanted slowly into the sample bottles. The work plan should be referenced for a description of how duplicate samples are to be collected. Additionally, in the case of wells that recover slowly and produce insufficient water to fill all the replicate sample containers, the containers should be filled incrementally and kept on ice in the cooler between filling periods.

2.2 TRIP BLANK:

A trip blank sample is a sample of distilled or de-ionized water prepared in the laboratory prior to sampling, and travels unopened in a common container with the sample bottles. (Note: USEPA uses the phrase "demonstrated analyte free water") It is later opened in the laboratory and analyzed along with field samples for constituent(s) of interest to ascertain whether cross-contamination has occurred during field handling, shipment, or in the laboratory. Trip blanks are primarily used to identify "artificial" contamination of the sample caused by airborne volatile organic compounds (VOCs) but may also be used to check for "artificial" contamination of the sample by a test substance or other analyte(s). One trip blank should accompany each cooler containing water samples that are being submitted for lab analysis.

2.3 EQUIPMENT BLANK:

An equipment blank sample is collected to evaluate decontamination procedures. It is a sample of analyte-free water which has been used to rinse reusable sampling equipment and is collected after completion of decontamination and prior to sampling. One equipment blank should be incorporated into the sampling program for each day's collection of samples and analyzed for the appropriate chemicals of concern. In some situations one equipment blank will be required for each type of sampling procedure (e.g., bailer, soil sampling equipment, etc.).

2.4 FIELD BLANK:

A field blank may be needed where ambient air quality may be poor. This field blank sample would be taken to determine if airborne contaminants interfere with constituent identification or quantification. This field blank sample is a sample bottle that is filled and sealed with "clean" (e.g., distilled/de-ionized/demonstrated analyte free) water in the analytical laboratory, and travels unopened with the sample bottles. It is opened in the field and exposed to the air at a location(s) to check for potential atmospheric interference(s). The field blank is resealed and shipped to the contract laboratory for analysis.

2.5 MATRIX SPIKE AND MATRIX SPIKE DUPLICATE:

Spikes of compounds (e.g., standard compound, test substance, etc.) are added to samples in the laboratory to determine if the matrix is interfering with constituent identification or quantification, as well as a check for systematic errors and lack of sensitivity of analytical equipment. Samples for spikes are collected in the identical manner as for standard analysis, and shipped to the laboratory for spiking. Matrix spike duplicate sample collection and laboratory spiking and analysis are performed to evaluate the reproducibility of matrix spike results. Additional sample volume may have to be collected for the laboratory to perform matrix spike/matrix spike duplicate samples.

3.0 PROCEDURE

1. Implement QC sampling as outlined above, depending on the type of QC sample(s) specified in the work plan.

2. Ensure unbiased handling and analysis of duplicate and blank QC samples by concealing their identity by means of coding so that the analytical laboratory cannot determine which samples are included for QC purposes. Attempt to use a code that will not cause confusion if additional samples are collected or additional monitoring wells are installed. For example, if there are three existing monitoring wells (MW-1, 2 and 3), do not label the QC blank MW-4. If an additional monitoring well were installed, confusion could result.

3. Verify that each sample container is properly placed in the cooler, and that the cooler has sufficient ice (wet ice or blue packs) to preserve the samples for transportation to the analytical laboratory. Consult the site work plan to determine if a particular ice is specified as the preservative for transportation (e.g., the USEPA prefers the use of wet ice because they claim that blue ice will not hold the samples at 4E C).

4. Document the QC samples on the appropriate field form and in the field notebook. On the chain-of-custody form, duplicate and blank QC samples will be labeled using codes, and matrix spike and field matrix spike QC samples will be identified as such.

5. The collection of quality control samples will follow KDHE=s various media specific SOPs:

   - SOP BER-01 for the Collection of Ground Water Samples;
   - SOP BER-2 Collection of Surface Water Samples;
   - SOP BER-3 Collection of Soil Samples for Laboratory Analysis
   - SOP BER-4 Collection of Sediment Samples

4.0 REFERENCES

EPA, Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers. USEPA 542-S-02-001, (May 2002)

EPA, Guidance on Environmental Data Verification and Data Validation EPA QA/G-8 (EPA/240/R-02/004) (November 2002)

EPA, Environmental Investigations Standard Operating Procedures and Quality Assurance Manual, Region 4, (November 2001)

(4) Document the QC samples on the appropriate field form and in the field notebook. On the chain-of-custody form, duplicate and blank QC samples will be labeled using codes, and matrix spike and field matrix spike QC samples will be identified as such.

(5) The collection of quality control samples will follow KDHE's SOP BER-01 for the collection of ground water samples.